Sri Vasavi Engineering College (Autonomous)

(Sponsored by Sri Vasavi Educational Society)

(Approved by AICTE, New Delhi & Permanently affiliated to JNTUK, Kakinada)

(Accredited by NBA & NAAC with 'A' Grade, Recognized by UGC Under Section 2(f) & 12(B))

Pedatadepalli, Tadepalligudem, W.G.Dt, A.P-534101

Department of Mechanical Engineering

Agenda of the 6th BOS meeting of the department on 19-07-2022

Item No.1

Approval of course structure and syllabi for V, VI, VII & VIII semesters of B.Tech under V20 Regulations.

Item No.2

Approval of courses offered in Open Electives V, VI & VII Semester B.Tech., under V20 Regulations to the students of the other departments.

Item No.3

Approval of list of courses offering under Minors / honours of Engineering in B.Tech under V20 Regulations.

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Department of Mechanical Engineering

Date: 19-07-2022

Sixth meeting of BOS in Mechanical Engineering Department along with external members is held on 19/07/2022 at 02.00 PM in online mode through ZOOM meeting app.

The following members are present.

S. No	Name of the BOS Members
1.	Dr.N. Mohan Rao, Professor & Director (IIIPT & SDC),JNTUK.
2.	Dr. R.V. Chalam, Professor,NIT,Warangal
3.	Dr. A. Krishnaiah, Professor, Osmania University, Hyderabad
4.	Sri S.S. SubramanyaSastry, Head of Practice QMS Veave Technologies, Banglore, India.
5.	Sri A.Sai Krishna, Alumni, Renault Nissan Technology and business centre India Pvt. Ltd. Chennai.
6.	Dr. Ch.Rambabu, Professor & I/C Principal, SVEC
7.	Dr. M.V. Ramesh, Chairman & HOD, SVEC
8.	All the BOS internal members

Minutes of meeting

Chairman welcomed all the BOS members and introduced to all the BOS internal members.

Item No. 1: Approval of course structure and syllabi for V, VI, VII & VIII semesters of B.Tech under V20 Regulations.

- The approved course structure and syllabi for V, VI, VII & VIII semesters of B.Tech under V20 Regulations are attached in **Annexure-I.**

Item No.2 : Approval of courses offered in Open Electives V, VI & VII Semester B.Tech., under V20 Regulations to the students of the other departments.

- The approved list of courses offered in Open Electives V, VI & VII Semester B.Tech., under V20 Regulations to the students of the other departments are attached in **Annexure-II.**

Item No.3 : Approval of list of courses offering under Minors in Mechanical Engineering offering for other departments & honours of Mechanical Engineering in B.Tech under V20 Regulations.

- The approved list of courses offering under Minors in Mechanical Engineering offering for other departments & honours of Mechanical Engineering in B.Tech under V20 Regulations are attached in **Annexure-III.**

Chairman (Head –ME)

Head of the Department
Mechanical Engineering
Sri Vasavi Engineering College
TADEPALLIGUDEM-534101

Annexure - I

Course structure Approved in previous BOS under V20 Regulations

(For 2020 – 2021 Admitted Batch)

V SEMESTER							
S. No	**Category**	**Course Code**	**Course Title**	**Hours per week**			
				L	**T**	**P**	**C**
1	Professional Core course	V20MET11	Dynamics of machinery	3	0	0	3
2	Professional Core course	V20MET12	Metal Cutting & Machine Tools	3	0	0	3
3	Professional Core course	V20MET13	Design of Machine Members – I	3	0	0	3
4	Open Elective Course/Job oriented elective		Open Elective / Job Oriented Elective Course – I	3	0	0	3
5	Professional Elective courses		Professional Elective – I	3	0	0	3
6	Professional Core courses Lab	V20MEL08	Metal Cutting & Machine Tools Lab	0	0	3	1.5
7	Professional Core courses Lab	V20MEL09	Theory of machines lab	0	0	3	1.5
	Skill advanced course/ soft skill course*	V20SOC03	Soft Skills	1	0	2	2
	Mandatory course (AICTE suggested)	V20ENT04	Professional Communication Skills-III	2	0	0	MNC
	Summer Internship (Mandatory) after second year (to be evaluated during V semester			0	0	0	1.5
Total Credits				18	0	8	21.5

Total Contact Hours: 26 Total Credits: 21.5

VI SEMESTER							
S. No	**Category**	**Course Code**	**Course Title**	**Hours per week**			
				L	**T**	**P**	**C**
1	Professional Core course	V20MET14	Heat Transfer with Artificial Intelligence	3	0	0	3
2	Humanities and Social Sciences	V20MAT08	Operations Research	3	0	0	3
3	Professional Core course	V20MET15	Design of Machine Members – II	3	0	0	3
4	Professional Elective courses		Professional Elective – II	3	0	0	3
5	Open Elective Course/Job oriented elective		Open Elective / Job Oriented Elective Course – II	3	0	0	3
6	Professional Core course Lab	V20MEL10	Heat Transfer Lab	0	0	3	1.5
7	Professional Core course Lab	V20MEL11	Simulation of mechanical systems lab	0	0	3	1.5
8	Professional Core course Lab	V20MEL12	Computer Numerical Control Programming Lab	0	0	3	1.5
	Skill advanced course/ soft skill course*	V20SOC03	Certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies.	**1**	**0**	**2**	**2**
	Mandatory course (AICTE)	V20CEMC01	Intellectual Property Rights And Patents	2	0	0	MNC
Total Credits				18	0	11	21.5
Industrial/Research Internship (Mandatory) during summer vacation							

Total Contact Hours: 29 Total Credits: 21.5

VII SEMESTER							
S. No	**Category**	**Course Code**	**Course Title**	**Hours per week**			
				L	**T**	**P**	**C**
1	Professional Elective courses		Professional Elective III	3	0	0	3
2	Professional Elective courses		Professional Elective IV	3	0	0	3
3	Professional Elective courses		Professional Elective V	3	0	0	3
4	Open Elective Course/Job oriented elective		Open Elective / Job Oriented Elective Course – III	3	0	0	3
5	Open Elective Course/Job oriented elective		Open Elective / Job Oriented Elective Course – IV	3	0	0	3
6	***Humanities and Social Science Elective**	V20MBT54	Universal Human Values	3	0	0	3
	Skill advanced course/ soft skill course*	V20SOC04	Certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies.	1	0	2	2
	Industrial/Research Internship (Mandatory) after third year (to be evaluated during VII semester			0	0	0	3
Total Credits				19	0	2	23

Total Contact Hours: 21 Total Credits: 23

VIII SEMESTER							
S. No	**Category**	**Course Code**	**Course Title**	**Hours per week**			
				L	**T**	**P**	**C**
1	Major Project	V20MEP01	Project Project work, seminar and internship in industry	0	0	0	12
	INTERNSHIP (6 MONTHS)						
Total Credits				0	0	0	12

Professional Electives:	
Professional Elective – I V20MEPE1 – Internal Combustion Engines and Air Compressors V20MEPE2 – Nanotechnology V20MEPE3 – Composite Materials	**Professional Elective – II** V20MEPE4 – Tool and Die Design V20MEPE5 – Industrial Automation and Robotics V20MEPE6 – Product design and Development
Professional Elective – III V20MEPE7 – Finite Element Methods V20MEPE8 – Tribology V20MEPE9 – Micro Electro Mechanical Systems	**Professional Elective – IV** V20MEPE10 – Automobile Engineering V20MEPE11 – Cryogenics V20MEPE12 – Design for Manufacturing & Assembly
Professional Elective – V V20MEPE13 – Power plant Engineering V20MEPE14 – Non Destructive Testing & Evaluation V20MEPE15 – Gas dynamics & Jet Propulsion	

Job Oriented Courses:	**Open Electives:**
V20MEJO1 – CAD/CAM V20MEJO2 – Refrigeration and Air conditioning V20MEJO3 – Integration of AI & ML in Mechanical Engineering V20MEJO4 – Industrial Safety & Management V20MEJO5 – Industrial Hydraulics & Pneumatics V20MEJO6 – Automation in Manufacturing	V20MEOE1 – Basic Mechanical Engineering V20MEOE2 – Green Engineering Systems V20MEOE3 – Computational Fluid Dynamics V20MEOE4 – Rapid Prototyping V20MEOE5- Computer Aided Design V20MEOE6 - Mechatronics

Syllabi for the courses offered in V semester B. Tech under V20 Regulation for the Academic Year 2022-2023

V Semester

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MET11
Name of the Course	Dynamics of machinery					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Apply gyroscopic effect for stabilization of sea vehicles, aircrafts and automobile Vehicles etc.,	K3
CO2	Apply friction for torque transmission of mechanical systems	K3
CO3	Interpret dynamic force analysis of slider crank mechanism in design of flywheel and different types of Governors for stability	K3
CO4	Understand balancing of reciprocating and rotary masses.	K2
CO5	Understand how to determine the natural frequencies of continuous systems starting from the general equation of displacement.	K2

UNIT – I

PRECESSION: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships.

UNIT – II

FRICTION: Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis.

CLUTCHES: Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch.

BRAKES AND DYNAMOMETERS: Simple block brakes, internal expanding brake, band brake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission.

UNIT – III

TURNING MOMENT DIAGRAMS: Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams, fluctuation of energy, fly wheels and their design.

GOVERNERS: Watt, porter, proell and Hartnell governors, sensitiveness, isochronisms and hunting.

UNIT – IV

BALANCING: Balancing of rotating masses single and multiple, single and different planes, use analytical and graphical methods. Primary and secondary balancing of reciprocating masses. analytical and graphical methods, unbalanced forces and couples, examination of "V" multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing, hammer blow, swaying couple, variation of tractive effort.

UNIT – V

VIBRATIONS: Free Vibration of spring mass system, oscillation of pendulums, centers of oscillation and suspension. Transverse loads, Natural frequency, types of damping, damped free vibration. vibrations of beams with concentrated and distributed loads. Dunkerly's methods, Raleigh's method, whirling of shafts, critical speeds, torsional vibrations, two and three rotor systems, Simple problems on forced damped vibration, vibration isolation and transmissibility.

TEXT BOOKS:

1. Theory of Machines / S.S Rattan/ Mc. Graw Hill Publ.
2. Mechanism and machine theory by Ashok G. Ambedkar, PHI Publications.

REFERENCE BOOKS:

1. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age.
2. Theory of Machines / Shiegly / MGH
3. Theory of Machines / Thomas Bevan / CBS Publishers
4. Theory of machines / Khurmi / S.Chand.

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MET12
Name of the Course	Metal Cutting & Machine Tools					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Describe the mechanism of chip formation and forces involved while machining	K2
CO2	Describe various types of lathe, shaper, slotter, planar and drilling machines and their operations.	K2
CO3	Explain the construction and working of various milling and grinding machines.	K2
CO4	Discuss the basic principle and working of Ultrasonic machining, Abrasive jet machining and Electrochemical machining.	K2
CO5	Explain the basic principle and working of Electric discharge machining, electron beam machining, Laser beam machining.	K2

UNIT – I

FUNDAMENTALS OF MACHINING: Elementary treatment of metal cutting theory – element of cutting process –geometry of single point tool angles, chip formation and types of chips – built up edge and its effects chip breakers, mechanics of orthogonal cutting –Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, coolants, tool materials.

UNIT – II

LATHE: Engine lathe, principle of working, specification of lathe, types of lathe, work holders tool holders, operations.

SHAPING, SLOTTING AND PLANNING MACHINES: Principles of working – principal parts – specifications, operations performed.

DRILLING: Principles of working, specifications, types, operations performed, tool, work holding devices

UNIT – III

MILLING MACHINES: Principles of working, specifications, classification of Milling Machines, Principle features of horizontal, vertical and universal Milling Machine, machining operations, types of cutters, methods of indexing.

FINISHING PROCESSES: Theory of grinding, classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds, specification and selection of a grinding wheel.

UNIT – IV

Need for non-traditional machining -Ultrasonic machining (USM), Abrasive jet machining (AJM), Electro-chemical machining (ECM)-Basic principle, equipment, applications, advantages and limitations.

UNIT – V

Electric Discharge Machining (EDM), Electron Beam Machining (EBM), Laser Beam Machining (LBM)-Basic principle, equipment, applications, advantages and limitations.

TEXT BOOKS:

1. Production Technology by R.K. Jain and S.C. Gupta.
2. Workshop Technology – B.S. Raghuwanshi – Vol II/DhanpatRai& Co. (P) Ltd
4. Elements of Workshop Technology Vol 2- S K Hajrachoudhury/Asia Publishing House
3. Advanced machining processes/ VK Jain/ Allied publishers.

REFERENCE BOOKS:

1. Metal cutting Principles by M.C. Shaw
2. Metal cutting and machine tools by Boothroyd
3. Manufacturing technology II, P.N Rao
4. Production Technology by H.M.T. (Hindustan Machine Tools).

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MET13
Name of the Course	Design of Machine Members – I					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the stresses on design of machine elements.	K2
CO2	Apply the varying loads on machine elements	K3
CO3	Solve problems in bolted, welded and riveted joints	K3
CO4	Illustrate various types of Keys and cotter joints	K3
CO5	Apply the different type of loads on shafts and couplings	K3

UNIT – I

Design Methods: The art and science of machine design, types of design methods, stages in machine design, selection of materials, types of loads, factor of safety, Design for strength and rigidity, preferred numbers.

Theories of Failure: Maximum Principal stress theory, Maximum shear stress theory, Maximum principal strain theory, Maximum strain energy theory, Maximum distortion energy theory, impact loads, problems.

UNIT – II

Strength of Machine Elements: Stress Concentration, theoretical stress concentration factor, fatigue stress concentration factor, notch sensitivity, design for fluctuating stresses, endurance limit, Estimation of endurance strength, S-N curves, Goodman's line, soderberg's line, modified Goodman's line, Gerber parabola, related problems.

UNIT – III

Bolted Joints: Advantages , types of Bolted joints, stresses in bolts, bolts of uniforms strength bolted joints under eccentric loading, , locking devices.

Riveted Joints: Types of riveted joints, modes of failure, strength and efficiency of riveted joints, pitch of the rivets, design stresses, boiler joints, diamond joints, and riveted joints under eccentric loading.

Welded Joints: Types of welded joints, strength of welds, Design of simple welded joints.

UNIT – IV

Keys, Cotters and Knuckle Joints: Types of Keys, stresses in Keys, design of rectangular, square and taper Keys, design of spigot and socket, sleeve and cotter, jib and cotter joints and knuckle joints.

UNIT – V

SHAFTS: Design of solid and hollow shafts for strength and rigidity – design of shafts for combined bending and axial loads – shaft sizes – BIS code.

SHAFT COUPLING: Rigid couplings – muff, split muff and flange couplings, flexible couplings – flange coupling (modified).

Note: Design data book is NOT Permitted for examination

TEXT BOOKS:

1. R.K. Jain ,Machine Design, Khanna Publishers, New Delhi.
2. V.B.Bhandari ,Design of Machine Elements , TMH Publishers, New Delhi.

REFERENCE BOOKS :

1. Schaum‟sseries ,Machine Design, TMH Publishers, New Delhi.
2. Sadhu Singh, Machine Design, Khanna Publishers, New Delhi.
3. Joseph E. Shigely, Mechanical Engineering Design, TMH Publishers, New Delhi.
4. M.F. Spotts, Design of Machine Elements, PHI Publishers, New Delhi.
5. Pandya and Shah ,Machine Design, Charotar Publishers, Anand.

Data Hand Book :1. Mahadevan and Balaveera Reddy [1996], Machine Design Data Hand Book, CBS Publishers, New Delhi.

Semester	V	L	T	P	C	Course Code
Regulation	V20	0	0	3	1.5	V20MEL08
Name of the Course	Metal Cutting & Machine Tools Lab					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understanding various mechanism used in different machine tools	K2
CO2	Apply desired work holders and tool holder for specific work	K3
CO3	Operate different machine tools	K3

DETAILED SYLLABUS:

1. Introduction of general purpose machines -lathe, drilling machine, milling machine, shaper, planing machine, slotting machine, cylindrical grinder, surface grinder and tool and cutter grinder.
2. Step turning and taper turning on lathe machine
3. Thread cutting and knurling on -lathe machine.
4. Drilling and tapping
5. Shaping and planning
6. Slotting
7. Milling
8. Cylindrical surface grinding
9. Grinding of tool angles.

TEXT BOOKS:

Lab Manual

Semester	V	L	T	P	C	Course Code
Regulation	V20	0	0	3	1.5	V20MEL09
Name of the Course	Theory of Machines Lab					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the concepts on various machine elements such as governors, springs, flywheel and cam & follower	K2
CO2	Examine the motion of gyroscope and static & dynamic balancing of masses	K3
CO3	Understand the principles of various power transmission systems such as shafts, gears and belt & pulley	K2

LIST OF EXPERIMENTS:

1. To determine whirling speed of shaft theoretically and experimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyse the motion of a motorized gyroscope when the couple is applied along its spin axis.
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system.
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of a flywheel.
8. To plot follower displacement vs cam rotation for various Cam Follower systems.
9. To find coefficient of friction between belt and pulley.
10. To study simple and compound screw jack and determine the mechanical advantage , velocity ratio and efficiency.
11. To study various types of gears- Spur, Helical, Worm and Bevel Gears.

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE1
Name of the Course	Internal Combustion Engines and Air Compressors **Professional Elective – I**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the affects of various losses that occur in the actual engine operation and the working principles of I.C. Engines.	K2
CO2	Illustrate the function of fuel supply, ignition, lubrication and cooling systems of I.C. Engines.	K2
CO3	Interpret the combustion phenomena in S.I. and C.I. Engines and effect of various engine operating parameters on it.	K3
CO4	Calculate the performance parameters of I.C. Engines.	K3
CO5	Understand the classification and basic principles of compressors.	K2

UNIT – I

Air standard and actual cycles: Comparison of cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down, Loss due to gas exchange process, Loss due to Rubbing Friction.

Basics of IC Engines: Classification, working principles of two stroke and four stroke S.I. and C.I. Engines, Valve timing and port timing diagrams.

UNIT – II

Engine systems: Requirements of fuel supply system, components and working of simple carburettor, types of diesel injection system, requirements of ignition system, types of ignition systems, types of lubrication systems, types of cooling system.

UNIT – III

Combustion in S.I. Engines and C.I. Engines: Normal Combustion and abnormal combustion, Stages of combustion in S.I. Engine, Types of Abnormal combustion, Pre-ignition and knocking , Fuel requirements, fuel rating, Anti knock additives, Detonation and its Control.

Stages of combustion in C.I. Engines: Four stages of combustion, Delay period, Factors influencing delay period, Diesel knock, Control of diesel knock, types of combustion chamber, Fuel requirements and fuel rating.

UNIT – IV

Measurement, Testing and Performance of IC Engines: Engine performance Parameters, Measurement of engine power, determination of IP,BP, FP, IMEP, BMEP, various efficiencies, engine performance characteristics and affecting variables, preparation of the Heat balance sheet.

UNIT – V

Compressors:

Reciprocating Compressors : Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, saving of work, minimum work condition for two stage compression.

Rotary Compressors: Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

TEXT BOOKS:

1. Internal Combustion Engines, Ganesan.V, Tata McGraw Hill Publishing Company.
2. Thermal Engineering- Mahesh Rathore, Tata McGrawHill
3. I.C. Engines Fundamentals, Heywood J.McGraw Hill publications.

REFERENCE BOOKS:

1. Thermal Engineering, R.K.Rajput, Lakshmi Publications.
2. Heat engines, Vasandani, Kumar Publications.
3.Thermal Engineering, P.L.Ballany, Khanna Publications.

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE2
Name of the Course	Nanotechnology **Professional Elective – I**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the essential concepts used in nanotechnology	K2
CO2	Identify the various nano materials properties	K2
CO3	Describe the syntheses and fabrication methods	K2
CO4	Explain the various characterization Techniques	K2
CO5	Use of the various applications of nanotechnology	K3

UNIT – I

INTRODUCTION: History of nano science, definition of nano meter, nano materials, nanotechnology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes. Band structure.

UNIT – II

PROPERTIES OF MATERIALS: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

UNIT – III

SYNTHESIS AND FABRICATION: Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top Down Approach – Ball milling, micro fabrication, lithography. Requirements for realizing semiconductor nano structures, growth techniques for nano structures.

UNIT – IV

CHARECTERIZATION TECHNIQUES:X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy.

UNIT –V

APPLICATIONS OF NANO TECHNOLOGY: Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin fins, applications of quantum dots.

TEXT BOOKS:

1. Nano science and nanotechnology by M.S Rama Chandra Rao, Shubra Singh, Wiley publishers.

REFERENCE BOOKS:

1. Introduction to Nano Technology by Charles P. Poole, Jr., Frank J.Owens, Wiley publishers.
2. Nanotechnology by Jermy J Ramsden, Elsevier publishers.
3. Nano Materials- A.K.Bandyopadhyay/ New Age Introdu.
4. Nano Essentials- T.Pradeep/TMH.
5. Nanotechnology the Science of Small by M.A Shah, K.A Shah, Wiley Publishers.

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE3
Name of the Course	Composite Materials **Professional Elective – I**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Classify the composites, explain the required properties, reinforcements and uses of composites.	K2
CO2	Explain how common fibers are produced and how the properties of the fibers are related to the internal structure and the interfaces obtained.	K2
CO3	Illustrate the processing techniques for polymer matrix, ceramic matrix and metal matrix composites and list out their properties and applications	K3
CO4	Construct different ceramic composite materials	K3
CO5	Examine the processing of ceramic matrix composites and Calculate mechanical properties of composite materials	K3

UNIT – I

Introduction, Classification of Composite materials based on structure and matrix and reinforcements, Advantages and applications of composites, Functional requirements of reinforcement and matrix materials. Difference between composites and metals &alloys, Properties of composites in comparison with standard materials

UNIT – II

Types of reinforcements and their properties: Glass, Carbon, Boron, Aramid, Al_2O_3 and SiC fibers. Nature and manufacture of glass, carbon and aramid fibers.

Role of interfaces: Wettability and Bonding, the interface in Composites, Interactions and Types of bonding at the Interface.

UNIT – III

Fabrication of Polymeric Matrix Composites, Structure and properties of Polymeric Matrix Composites, Interface in Polymeric Matrix Composites, Applications.

Fabrication of Metal Matrix Composites (MMC): Solid state fabrication, Liquid state fabrication and In-situ fabrication techniques. Interface in Metal Matrix Composites. Mechanical bonding, Chemical bonding and Interfaces in In-situ Composites. MMC: Properties and Applications.

UNIT – IV

Fabrication of Ceramic Matrix Composites (CMC): Processing of CMCs: Cold Pressing and Sintering, Hot Pressing, Reaction Bonding Processes, Infiltration, Sol–Gel process. Interface in CMCs. Properties of CMCs, Applications of CMCs.

UNIT – V

Mechanical Testing of Composites and Their Constituents: Measurement of Constituent Material Properties Fiber Tests, Neat Resin Matrix Tests, Constituent Volume Fraction Measurement. Measurement of Basic Composite Properties: Tensile Tests, Compressive Tests, Shear Tests, Flexure Tests, Fiber/Matrix Interface Tests.

TEXT BOOKS:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York,1987.
2. Principles of Composite Material Mechanics, Ronald F. Gibson
3. An Introduction to Composite Materials, Hull, Cambridge, 2nd Edt.1997.

REFERENCE BOOKS:

1. Composites, Engineered Materials Handbook, Vol.1, ASM International, Ohio, 1988.
2. Structure and Properties of Composites, Materials Science and Technology, Vol. 13, VCH, Weinheim,
   Germany, 1993
3. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman & Hall, London, 1994.

Syllabi for the courses offered in VI semester B. Tech under V20 Regulation for the Academic Year 2023-2024

VI Semester

Semester	VI	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MET14
Name of the Course	Heat Transfer with Artificial Intelligence					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Illustrate the basic modes of heat transfer, basic laws of heat transfer and to develop solution for one dimensional steady state heat conduction problems.	K3
CO2	Interpret the heat transfer through extended surfaces, to find solution for one dimensional extended surfaces and unsteady state heat conduction problems.	K3
CO3	Illustrate convective heat transfer and to apply Dimensional analysis concept to convective heat transfer and Apply empirical correlations for phase change process to calculate values for the convection heat transfer coefficient	K3
CO4	Illustrate Heat Exchangers and concepts of Artificial Intelligence.	K3
CO5	Employ the principles of radiation heat transfer, to find the shape factor and heat transfer rate through radiation.	K3

UNIT – I

Introduction: Different Modes of Heat Transfer, Governing Laws of Heat Transfer, Applications of Heat Transfer.

Conduction heat transfer: General Heat Conduction Equation: Derivation of the equation in (i) Cartesian, (ii) Polar and (iii) Spherical Co-ordinate Systems.

Steady-state one-dimensional heat conduction in Cartesian System: Steady-state one-dimensional heat conduction problems (i) without heat generation and (ii) without variable thermal conductivity, Thermal Resistances in Series and in Parallel and Numerical Problems.

Steady-state radial heat conduction in Polar and spherical Systems: Steady-state one-dimensional heat conduction problems (i) without heat generation and (ii) without varying thermal conductivity, Thermal Resistances in Series and Numerical Problems.

Critical Thickness of Insulation: Concept, Derivation and Numerical Problems.

UNIT – II

Extended Surfaces (Fins): Classification, Applications, Straight Rectangular Fins - long fin, fin with insulated tip and short fin, Temperature Distribution and Heat Transfer Calculations, Fin Efficiency and Effectiveness and Numerical Problems.

One dimensional Transient (Unsteady-state) conduction heat transfer: Definition, Systems with negligible internal resistance, Numerical Problems, Heisler and Gober charts: Solutions to various one-dimensional problems using the charts, Numerical problems.

UNIT – III

Convective heat transfer: Classification of convective heat transfer, dimensional analysis – application of Buckingham Pi Theorem for forced and free convection, Significance of non-dimensional numbers, concepts of continuity, momentum and Energy Equations, boundary layer theory.

Heat transfer with phase change: Boiling: Definition, types, regimes of Pool boiling - Numerical Problems on nucleate boiling, critical heat flux and film boiling using empirical correlations.

Condensation: Definition, Film wise and drop wise condensation, Numerical Problems on film condensation over vertical and horizontal cylinders using empirical correlations.

UNIT –IV

Radiation heat transfer: Fundamental principles - Gray, White, Opaque, Transparent and Black bodies, Emissivity, Planck's distribution law, Wien's displacement law, Kirchoff's law, Lambert's cosine law and the Stefan-Boltzmann law, Irradiation, total and monochromatic quantities, concepts of shape factor, heat exchange between two black bodies, heat exchange between grey bodies, radiation shields, electrical analogy for radiation networks and Numerical problems.

UNIT – V

Heat Exchangers: Definition, Classification, LMTD method, Effectiveness - NTU method, overall heat transfer coefficient, fouling factor and Numerical Problems.

Chart Solution Procedures for solving Heat Exchanger problems: Correction Factor Charts and Effectiveness-NTU Charts and Numerical Problems.

Artificial Intelligence: Introduction, Biological and Artificial Neuron, Artificial Neural Network, Training of Artificial Neural Network, Perceptron learning rule, Convergence Theorem, Activation Functions, Delta Rule, Generalised Delta Rule, Back Propagation Algorithm, Genetic Algorithm – Terminology, Working.

TEXT BOOKS:

1. Heat Transfer, JP HOLMAN, Tata McGraw Hill Publications, Special Indian edition.
2. Heat Transfer, P.K.Nag, Tata McGraw Hill Publications.
3. Fundamentals of Engineering Heat and Mass Transfer, R.C.Sachdeva, New Age International Publications.
4. Artificial Intelligence, Saroj Kaushik, 1st Edition, Cengage Learning
5. Artificial Intelligence – A modern Approach, 3rd Edition, Stuart Russel, Peter Norvig, Pearson Education

REFERENCE BOOKS:

1. Heat and Mass Transfer, Cengel, McGraw Hill Publications.
2. Principles of Heat Transfer, Frank Kreith, R. M. Manglik& M. S. Bohn, Cengage learning publishers.
3.Heat and Mass Transfer /D.S.Kumar / S.K.Kataria& Sons
4. Heat and mass transfer, R.K. Rajput, S. Chand Publications, Revised edition
5.Artificial Intelligence, Elaine Rich, Kevin Knight, Shivashankar B Nair, 3rd Edition, Tata McGraw Hill Education Private Limited., 2009

Semester	VI	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MET15
Name of the Course	Design of Machine Elements – II					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Apply the concepts of different types of Bearings for design	K3
CO2	Illustrate the design concept of IC Engine Parts	K3
CO3	Employ the design concepts to curved beams	K3
CO4	Examine different Transmissions Systems and mechanical springs	K2
CO5	Analyze the design of Spur & Helical Gears	K4

UNIT – I

Design of Bearings: Applications and types of Journal bearings, Lubrication, Bearing Modulus, clearance ratio, bearing materials, journal bearing design, Ball and roller bearings, Static loading of ball & roller bearings, bearing life, Failure of bearings. Selection of Anti-friction bearings

UNIT – II

Design of Engine Parts: Design of piston, forces acting on piston. Design of Cylinder, Cylinder block. Design of Connecting Rod, stress due to whipping action on connecting rod ends. Design of Cranks and Crank shafts-Centre and over hung cranks.

UNIT – III

Design of Curved Beams: Introduction, Stresses in curved beams, Expression for radius of neutral axis for rectangular, circular, trapezoidal and T-Section. Design of crane hooks, C –clamps, problems.

UNIT – IV

Power Transmissions Systems, Pulleys: Transmission of power by belt and rope drives, transmission efficiencies, belts – flat and V types, ropes, pulleys for belt and rope drives, materials, chain drives, problems. Selection of V-Belts.

Mechanical Springs: Stress and deflections of helical Springs, Compression springs, Springs for fatigue loading, Natural frequency of helical springs, Energy storage capacity. Shear stress multiplication Factor, Wahl correction factor and design of helical springs under static and dynamic loads. Design of leaf springs, co-axial springs, related problems.

UNIT – V

Spur & Helical Gear drives: Spur gears, Helical gears, Load concentration factor, Dynamic load factor, Surface compressive strength, Bending strength, Design analysis of spur and Helical gears, Estimation of centre distance, module and face width, Check for dynamic and wear considerations, problems.

Note: Design data book is permitted for examination

TEXT BOOKS:

1. Machine Design/V.Bandari/TMH Publishers
2. Machine Design/ NC Pandya & CS Shaw/ Charotar publishers
3. Design data book.

REFERENCE BOOKS:

1. Machine Design: An integrated Approach / R.L. Norton / Pearson Education
2. Mech. Engg. Design / JE Shigley/Tata McGraw Hill education
3. Design of machine elements- spots/Pearson Publications
4. Machine Design-Norton/Pearson Publications

Semester	VI	L	T	P	C	Course Code
Regulation	V20	0	0	3	1.5	V20MEL10
Name of the Course	Heat Transfer Lab					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Evaluate the amount of heat exchange in various modes of heat transfer for several geometries.	K4
CO2	Evaluate the amount of heat exchange in condensation & boiling processes and for heat exchangers.	K4

List of experiments:

1. Determination of overall heat transfer co-efficient of a composites lab.
2. Determination of efficiency of a pin-fin.
3. Determination of heat transfer rate through a lagged pipe.
4. Determination of thermal conductivity of a metal rod.
5. Determination of Thermal conductivity of liquid sand gases.
6. Determination of heat transfer rate through a concentric sphere.
7. Determination of heat transfer coefficient in natural and forced convection
8. Determination of emissivity of a given surface.
9. Determination of Stefan Boltzman constant.
10. Determination of effectiveness of parallel and counter flow heat exchangers.
11. Determination of heat transfer rate in drop and film wise condensation.
12. Determination of critical heat flux.

Add-on experiments: Heat transfer modeling of a simple component used in a heat exchanger using Ansysin the lab(Virtual lab)

Semester	VI	L	T	P	C	Course Code
Regulation	V20	0	0	3	1.5	V20MEL11
Name of the Course	Simulation of Mechanical Systems Lab					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Examine the stress analysis of trusses.	K3
CO2	Interpret the deflection analysis of different type of loads.	K3
CO3	Illustrate the stress analysis of different components.	K3
CO4	Develop the modal analysis of beams.	K3
CO5	Practice the basics of simulation using MATLAB	K3

Introduction to software

Introduction to SOLIDWORKS

List of Experiments:

SOLIDWORKS

1. Part design of different components using Solid works
2. Assembly of given parts using Solid works
3. Thermal analysis of a rectangular plate with circular hole (steady state)
4. Thermal analysis of a rectangular plate with circular hole (transient)
5. Stress analysis of the corner angle bracket
6. Stress analysis of an axis-symmetric component
7. Thermal stress analysis within the rectangular plate
8. Model analysis of cantilever beam without load
9. Model analysis of cantilever beam with load

FEMAP

1. Force and stress analysis using four link elements in trusses
2. Stress and deflection analysis in simply supported beam with point load
3. Stress and deflection analysis in simply supported beam with uniformly varying load
4. Stress and deflection analysis in simply supported beam with uniformly distributed load

Semester	VI	L	T	P	C	Course Code
Regulation	V20	0	0	3	1.5	V20MEL12
Name of the Course	Computer Numerical Control Programming Lab					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Describe the features of CNC Machine Tool.	K2
CO2	Examine the applications of various CNC machines like CNC lathe, CNC Vertical	K3
CO3	Interpret CNC Programmes for turning applications	K3
CO4	Prepare CNC programmes for milling applications	K3
CO5	Review modern control systems	K2

CNC LATHE OPERATIONS

1. FACING CYCLE
2. TURNING CYCLE
3. STEP TURNING
4. TAPER TURNING
5. TURNING - CIRCULAR INTERPOLATION
6. THREADING

CNC MILLING OPERATIONS

1. LINEAR AND CIRCULAR INTERPOLATION
2. ENGRAVING
3. MIRRORING
4. ROTATION
5. CIRCULAR POCKETING
6. RECTANGULAR POCKETING

Semester	VI	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE4
Name of the Course	Tool and Die Design **Professional Elective – II**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Describe various tool materials and their applications.	K2
CO2	Construct cutting die with required specifications	K3
CO3	Construct non-cutting die with required specifications	K3
CO4	Explain various types of jigs and fixtures with design data	K2
CO5	Discuss various components and types of die casting dies	K2

UNIT – I

Tool Materials properties and applications of Carbon steels – plain carbon steels, plain carbon spring steels, plain carbon free cutting steels.

Case hardening steels – Case hardening alloy steels, Nitriding steels.

Tool steels-Cold work water hardening steel, cold work oil/air hardening steel, hot work tool steel

UNIT – II

PRESS TOOLS (Cutting dies)

Introduction, components of simple die, press features, types of dies, clearance between die and punch, dowels and screws, punch holder and die holder, press work operations, cutting force, die block design, punch design, stripper plate, die springs, stock strip stops, strip payout, design procedure of cutting dies, design calculations.

UNIT – III

PRESS TOOLS (Non-Cutting dies)

Bending dies-Introduction, types of bending, bending force, bend allowance, spring back

Forming-Introduction, types of forming dies

Drawing-Introduction, drawing dies, factors effecting drawing, blank size calculation, clearance between punch and die, draw ratio, thickness ratio, drawing force, blank holder pressure, redrawing, ironing, calculation of number of draws, lubricants for drawing, design procedure for drawing die, design calculations for drawing die

UNIT – IV

JIGS AND FIXTURES

Introduction, advantages, design principles, design factors, design steps, location, rules for location, degrees of freedom, 3-2-1 principle of location, locating methods and devices, diamond pin locator, fool proofing, jig bushes, clamping devices, types of clamping devices, box jig, leaf jig, milling fixture, grinding fixture

UNIT – V

DIE CASTING DIE

Introduction, steps of die casting process, types of die casting processes, die casting alloys, advantages, limitations, applications of die casting, hot chamber and cold chamber machines.

TEXT BOOKS:

1. Industrial steel reference book by S N Bagchi, kuldipprakash by New age international publishers.
2. Press Tools Design and Construction by Joshi P. H. by S Chand & Co Ltd
3. Jigs and fixtures Design manual by P H Joshi by McGraw-Hill companies

REFERENCE BOOKS:

1. Tool Engineering, jigs and fixtures by Albert A. Dowd and Frank W. Curtis by McGraw-Hill companies.
2. ASM Hand book Vol14 Forming and forging by ASM International

Semester	VI	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE5
Name of the Course	Industrial Automation and Robotics **Professional Elective – II**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Describe various robot configuration and components.	K2
CO2	Select appropriate actuator sand sensors for a robot based on specific application.	K3
CO3	Apply kinematic and dynamic analysis for simple serial kinematic chains.	K3
CO4	Explain trajectory planning for a manipulator	K2
CO5	Understand the Robot Actuators And Feed Back Components	K2

UNIT – I

INTRODUCTION TO INDUSTRIAL AUTOMATION: Importance of the automation of an industrial system. Basic concepts: plant, control, operator, sensors, drives, open loop control, closed loop control, continuous processes, discrete processes, mixed processes, batch processing. Functional and physical architecture of the control of a system. Automation pyramid. Function of each level. Technological elements of each level: sensor networks, field buses, controllers (PLCs), instrumentation, drives, robots, plant buses, RTUs, local area networks and control centers. OSI communications model. Control types: centralized, distributed. Real time control.

UNIT – II

INTRODUCTION TO ROBOTICS: Automation principle in Robotics, CAD/CAM and Robotics–An overview of Robotics–present and future applications, classification by coordinate system.

COMPONENTS OF THE INDUSTRIAL ROBOTICS: Function line diagram representation of simple Robot, Components. Degrees of freedom –Requirements and challenges of end effectors. Mechanical, Electrical and hydraulic grippers.

UNIT– III

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems. MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems. Differential transformation and manipulators, Jacobians– problems.

UNIT– IV

GENERAL CONSIDERATIONS IN PATH DESCRIPTION AND GENERATION : Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages, and software packages-description of paths with a robot programming language.

ROBOT ACTUATORS AND FEED BACK COMPONENTS: Actuators: Pneumatic, Hydraulic actuators, electric & step per motors.

UNIT– V

FEEDBACK COMPONENTS: Position sensors –potentiometers, resolvers, encoders and Velocity, proximity sensors.

ROBOT APPLICATIONS IN MANUFACTURING: Material Transfer–Material handling, loading, and unloading – Processing– spot and continuous arc welding & spray painting –Assembly and Inspection.

TEXT BOOKS:

1. Industrial Robotics/ Groover MP/ Pearson Edu.
2. Robotics and Control/Mittal RK & Nagrath IJ /TMH.

REFERENCE BOOKS:

1. Robotics/ FuK S/McGraw Hill.
2. Robotic Engineering/ Richard D.Kl after, Prentice Hall
3. Robot Analysis and Intelligence/ Asada and Slow time/ Wiley Inter-Science.
4. Introduction to Robotics /John JCraig / Pearson Edu.

Semester	VI	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE6
Name of the Course	Product Design and Development **Professional Elective – II**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Discuss proto typing of a product that meets established requirements.	K2
CO2	Describe product development, manufacturing and management.	K2
CO3	Investigate risk and identify corrective action.	K4
CO4	Experiment different tests and assess data.	K3
CO5	Illustrate maintenance concepts and product standardization.	K3

UNIT – I

Product Design Process: Design Process Steps, Morphology of Design. Problem Solving and Decision Making: Problem-Solving Process, Creative Problem Solving, Invention, Brainstorming, Morphological Analysis, Behavioral Aspects of Decision Making, Decision Theory, Decision Matrix, Decision Trees.

Modeling and Simulation: Triz, Role of Models in Engineering Design, Mathematical Modeling, Similitude and Scale Models, Computer Simulation, Geometric Modeling on Computer, Finite- Element Analysis.

UNIT – II

Product management: The operation of product management: Customer focus of product management , product planning process, Levels of strategic planning, Wedge analysis, Opportunity search, Product life cycle Life cycle theory and practice.

Product development: Managing new products, Generating ideas, Sources of product innovation, Selecting the best ideas, The political dimension of product design, Managing the product launch and customer feedback.

Product managers and manufacturing: The need for effective relationships, The impact of manufacturing processes on product decisions, Prototype planning,, Productivity potentials, Management of product quality, Customer service levels.

UNIT – III

Risk and Reliability: Risk and Society, Hazard Analysis, Fault Tree Analysis. Failure Analysis and Quality: Causes of Failures, Failure Modes, Failure Mode and Effect Analysis, FMEA Procedure, Classification of Severity, Computation of Criticality Index, Determination of Corrective Action, Sources of Information, Copyright and Copying. Patent Literature.

UNIT – IV

Product Testing: thermal, vibration, electrical, and combined environments, temperature testing, vibration testing, test effectiveness. Accelerated testing and data analysis, accelerated factors. Weibull probability plotting, testing with censored data.

UNIT – V

Design For Maintainability: Maintenance Concepts and Procedures, Component Reliability, Maintainability and Availability, Fault Isolation in design and Self-Diagnostics. Product Design for Safety, Product Safety and User Safety Concepts, Examples of Safe Designs. Design Standardization and Cost Reduction: Standardization Methodology, Benefits of Product Standardization; International, National, Association and Company Level Standards; Parts Modularization

TEXT BOOKS:

1. Engineering Design , George E. Dieter, McGRAW-HILL
2. Product Integrity and Reliability in Design, John W. Evans and Jillian Y. Evans, Springer Verlag

REFERENCE BOOKS:

1. The Product Management Handbook, Richard S. Handscombe, McGRAW-HILL
2. New Product Design, Ulrich Eppinger,
3. Product Design, Kevin Otto.

Syllabi for the courses offered in VII semester B. Tech under V20 Regulation for the Academic Year 2023-2024

VII Semester

Semester	VII	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE7
Name of the Course	Finite Element Methods **Professional Elective – III**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Use the concepts of variational methods and weighted residual methods in FEM.	K3
CO2	Use Finite Element Formulation for solving the problems.	K3
CO3	Solve the problems of Truss elements and Beam elements by FEM.	K3
CO4	Use FEM to solve 2D CST problems.	K3
CO5	Apply finite element method for problems involving dynamics and heat transfer.	K3

UNIT – I

INTRODUCTION TO FINITE ELEMENT METHOD: stress and equilibrium, strain – displacement relations, stress-strain relations, plane stress and plane strain conditions, variational and weighted residual methods, the concept of potential energy, one-dimensional problems.

UNIT – II

FINITE ELEMENT FORMULATION: Discretization of the domain, element shapes, discretization procedures, assembly of stiffness matrix, bandwidth, node numbering, mesh generation, interpolation functions, convergence requirements, Treatment of Boundary conditions, Derivation of element stiffness matrix for Bar elements and problems

UNIT – III

ANALYSIS OF TRUSSES: Finite element modelling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations.

ANALYSIS OF BEAMS: Derivation of Element stiffness matrix for beam element, derivation of load vector for concentrated and UDL, Problems on Cantilever, simply supported beams with point and uniformly distributed loads.

UNIT – IV

Finite element modelling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems,

HIGHER ORDER AND ISOPARAMETRIC ELEMENTS: One dimensional quadratic and cubic elements in natural coordinates, two dimensional four node disoparametric elements, numerical integration.

UNIT-V

STEADY STATE HEAT TRANSFER ANALYSIS: one dimensional analysis of a fin and two dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion.

DYNAMIC ANALYSIS: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis.

TEXT BOOKS:

1. The Finite Element Methods in Engineering / S. S Rao / Pergamon.

REFERENCE BOOKS:

1. Finite Element Method with applications in Engineering / YM Desai, Eldho& Shah /Pearson publishers
2. An introduction to Finite Element Method / JN Reddy / McGraw Hill
3. The Finite Element Method for Engineers – Kenneth H. Huebner, Donald L. Dewhirst, Douglas E. Smithand Ted G. Byrom / John Wiley &Sons (ASIA) Pte Ltd.
4. Finite Element Analysis/ P.Seshu
5. Finite Element Methods: Basic Concepts and Applications ByChennakesava R. Alavala
6. Finite Element Analysis: for students & Practicing Engineers / G.LakshmiNarasaiah / BSP Books Pvt. Ltd.

Semester	VII	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE8
Name of the Course	Tribology **Professional Elective – III**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the fundamentals of tribology and associated parameters.	K2
CO2	Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.	K3
CO3	Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application.	K4
CO4	Select proper bearing materials and lubricants for a given tribological application.	K3
CO5	Apply the principles of surface engineering for different applications of tribology.	K3

UNIT – I

Introduction to tribology: Friction, Wear and Lubrication, practical importance. Lubricants: Types and specific field of applications. Properties of lubricants, viscosity, its measurement, effect of temperature and pressure on viscosity, lubrication types, standard grades of lubricants, and selection of lubricants.

UNIT – II

Friction: Origin, friction theories, measurement methods, friction of metals and non-metals.

Wear: Classification and mechanisms of wear, delamination theory, debris analysis, testing methods and standards. Related case studies.

UNIT – III

Hydrodynamic journal bearings: Friction forces and power loss in a lightly loaded journal bearing, Petroff's equation, mechanism of pressure development in an oil film, and Reynold's equation in 2D. Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's number and it's significance; partial bearings, end leakages in journal bearing, numerical examples on full journal bearings only.

UNIT – IV

Plane slider bearings with fixed/pivoted shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a fixed/pivoted shoe bearing, center of pressure, numerical examples.

Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing, numerical examples.

UNIT – V

Bearing Materials: Commonly used bearings materials, and properties of typical bearing materials. Advantages and disadvantages of bearing materials.

Introduction to Surface engineering: Concept and scope of surface engineering. Surface modification – transformation hardening, surface melting, thermo chemical processes. Surface Coating – plating, fusion processes, vapor phase processes. Selection of coating for wear and corrosion resistance.

TEXT BOOKS:

1."Introduction to Tribology", B. Bhushan, John Wiley & Sons, Inc., New York, 2002
2. "Engineering Tribology", Prasanta Sahoo, PHI Learning Private Ltd, New Delhi, 2011.
3."Engineering Tribology", J. A. Williams, Oxford Univ. Press, 2005.

REFERENCE BOOKS:

1. "Introduction to Tribology in bearings", B. C. Majumdar, Wheeler Publishing.
2. "Tribology, Friction and Wear of Engineering Material", I. M.Hutchings, Edward Arnold, London,1992.
3. "Engineering Tribology", G. W. Stachowiak and A. W. Batchelor, Butterworth-Heinemann,1992.
4. "Friction and Wear of Materials", Ernest Rabinowicz, John Wiley & sons,1995.
5. "Basic Lubrication Theory", A. Cameron, Ellis Hardwoods Ltd., UK.
6. "Handbook of tribology: materials, coatings and surface treatments", B.Bhushan, B.K. Gupta, McGraw-Hill,1997.

Semester	VII	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE09
Name of the Course	Micro Electro Mechanical Systems (MEMS) **Professional Elective – III**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand about the basics of MEMS, Methods of Micro machining.	K2
CO2	Interpret various Mechanical and Thermal sensors & Actuators	K3
CO3	Differentiate between different types of MOEMS devices	K2
CO4	Illustrate and explain various Magnetic sensors and Actuators & its applications	K3
CO5	Illustrate and explain various micro-fluidic devices & its applications	K3

UNIT – I

INTRODUCTION: Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, surface micro machining, Bulk micro machining , wafer bonding, LIGA.

UNIT – II

MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, pressure, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

THERMAL SENSORS AND ACTUATORS Thermal energy basics and heat transfer processes, thermo couple, micro hot plate gas sensors, pyro electricity, shape memory alloys (SMA).

UNIT – III

MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch.

UNIT – IV

MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor.

UNIT – V

MICRO FLUIDIC SYSTEMS: Applications, considerations on micro scale fluid, fluid actuation methods, dielectro phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), micro fluid dispenser, micro needle, micro pumps.

TEXT BOOKS:

1.MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.

REFERENCE BOOKS:

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Semester	VII	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE10
Name of the Course	Automobile Engineering **Professional Elective – IV**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand various components in four wheel automobile.	K2
CO2	Differentiate between different types of transmission systems used in automobile.	K4
CO3	Examine steering geometry and steering systems used in automobile and Interpret suspension systems in automobile	K3
CO4	Interpret breaking and electrical systems in automobile.	K3
CO5	Use various safety systems used in automobile and Practice engine service for different components in automobile.	K3

UNIT – I

INTRODUCTION: Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, no. of cylinders and arrangement, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, reboring, decarbonisation, Nitriding of crankshaft.

UNIT – II

TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft– Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles–types–wheels and tyres.

UNIT – III

STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears– types, steering linkages.

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

UNIT –IV

BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes.

ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT – V

SAFETYSYSTEMS: Introduction, safety systems - seatbelt, airbags, bumper, antilock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.

ENGINE SERVICE: Introduction, service details of engine cylinder head, valves and valve mechanism, piston connecting rod assembly, cylinder block, cranks haft and main bearings, engineer assembly-precautions.

TEXT BOOKS:

1. Automotive Mechanics –Vol.1&Vol.2/Kirpal Singh/standard publishers
2. Automobile Engineering/William Crouse/TMHD istributors
3. Automobile Engineering/P.SGill/S.K.Kataria & Sons/ New Delhi.

REFERENCE BOOKS:

1. Automotive Engines Theory and Servicing/James D. Halderman and Chase D. Mitchell Jr.,/ Pearson educationinc.
2. Automotive Engineering/K Newton,W.Steeds & TKGarrett/SAE
3. AutomotiveMechanics:PrinciplesandPractices/JosephHeitner/VanNostrandReinhold
4. Automobile Engineering/CSrinivasan/ McGrawHill

Semester	VII	L	T	P	C	Course Code
Regulation	V20	3	1	0	4	V20MEPE11
Name of the Course	Cryogenics **Professional Elective – IV**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Illustrate the basics for evolution of low temperature science, Understand properties of materials at cryogenic temperatures.	K3
CO2	Illustrate various liquefaction systems.	K3
CO3	Illustrate gas liquefaction systems.	K3
CO4	Illustrate Cryogenic Refrigeration systems.	K3
CO5	Illustrate Cryogenic fluid storage and transfer system.	K3

UNIT – I

Introduction to Cryogenic Systems, Historical development, Low Temperature properties of Engineering Materials, Mechanical properties- Thermal properties- Electric and magnetic properties – Cryogenic fluids and their properties.

Applications of Cryogenics: Applications in space, Food Processing, super conductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry. Low temperature properties of engineering materials.

UNIT – II

Liquefaction systems ideal system, Joule Thoms on expansion, Adiabatic expansion, Linde Hampson Cycle, Claude & Cascaded System, Magnetic Cooling, Stirling Cycle Cryo Coolers.

UNIT – III

Gas liquefaction systems: Introduction - Production of low temperatures - General Liquefaction systems - Liquefaction systems for Neon. Hydrogen and Helium – Critical components of Liquefaction systems.

UNIT –IV

Cryogenic Refrigeration systems: Ideal Refrigeration systems - Refrigeration using liquids and gases as refrigerant- Refrigerators using solids as working media.

UNIT – V

Cryogenic fluid storage and transfer systems: Cryogenic Storage vessels and Transportation, Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation, Cryogenic fluid transfer systems.

TEXT BOOKS:

1.R.B.Scott,CryogenicEngineering,VanNostrandCo., 1959
2.RandalF.Barron,Cryogenicsystems,McGraw Hill,1986

REFERENCE BOOKS:

1. Klaus D.Timmerhaus and Thomas M.Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989.

Semester	VII	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE12
Name of the Course	Design for Manufacturing and Assembly **Professional Elective – IV**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Explain how a design can be made suitable for various manufacturing and assembly processes.	K2
CO2	Express various factors influencing the manufacturability of components.	K2
CO3	Illustrate various metal casting, extrusion and sheet metal work.	K2
CO4	Apply different factors to joining processes.	K3
CO5	Explain various assembly systems and assembly lines.	K2

UNIT – I

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design?, Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology.

UNIT – II

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT – III

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT – IV

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT – V

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, single station assembly lines.

TEXTBOOKS:

1. Design for manufacture, John cobert,AdissonWesley.1995
2. Design for Manufacture and assembly by Boothroyd,3rd edition CRC press
3. Design for manufacture, James Bralla, 2nd edition Mc Graw Hill

REFERENCES BOOK:

1. ASM Hand book Vol.20, Taylor & Francis 1997

Semester	VII	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE13
Name of the Course	Power Plant Engineering **Professional Elective – V**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Explain the working and layout of steam power plant and the different systems comprising the plant.	K2
CO2	Describe the basic components and working principle of hydroelectric power plant.	K2
CO3	Explain the working principles, layouts of diesel power plant and gas turbine power plants.	K2
CO4	Describe the basic components and working principle of different reactors of nuclear power plant.	K2
CO5	Compute the power plant economics.	K3

UNIT – I

Introduction to the Sources of Energy.

Steam Power Plant: Plant layout, working of different circuits, coal handling equipment, ash handling systems, overfeed and underfeed fuel beds, types of stokers, dust collectors, cooling towers and feed water treatment.

UNIT – II

Hydro Electric Power Plant: Water power, hydrological cycle, hydrographs, classification of dams and spill ways.

Hydro Projects and Plant: Classification – typical layouts – plant auxiliaries – plant operation pumped storage plants.

UNIT – III

Diesel power Plant: IC Engines, types, Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system, super charging.

Gas Turbine Plant: Introduction, classification, construction, Layout with auxiliaries, Principles of working of closed and open cycle gas turbines, combined cycle power plants and comparison.

UNIT – IV

Nuclear Power Station: Nuclear fuel – breeding and fertile materials, nuclear reactor – reactor operation. Types of reactors and their operation - Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor. Radiation hazards and shielding, radioactive waste disposal.

UNIT – V

Power Plant Economics: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises.

TEXT BOOKS:

1. A course in Power Plant Engineering /Arora and Domkundwar/Dhanpatrai& Co.
2. Power Plant Engineering /P.C.Sharma / S.K.Kataria Pub

REFERENCE BOOKS:

1. Power Plant Engineering: P.K.Nag/ TMH.
2. Power station Engineering – M.M.Ei-Wakil / McGraw Hill.

Semester	VII	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE14
Name of the Course	Non Destructive Testing and Evaluation **Professional Elective – V**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Identify the flaws in manufacturing process through radiographic inspection	K2
CO2	Explain the theory of wave propagation and inspect the components using ultrasonic test	K2
CO3	Identify various surface, subsurface flaws with LPT and ECT	K2
CO4	Explain the principle of magnetic particle test system, flaw detection and evolution	K2
CO5	Explain the industrial applications in railways, nuclear, aerospace	K2

UNIT – I

Introduction to non-destructive testing, Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

UNIT – II

Ultrasonic test: Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection, Effectiveness and Limitations of Ultrasonic Testing.

UNIT – III

Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing.

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current Testing Effectiveness of Eddy Current Testing.

UNIT – IV

Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

UNIT – V

Industrial Applications of NDE: Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions.

TEXT BOOKS:

1. Non destructive test and evaluation of Materials/J Prasad, GCK Nair/TMH Publishers
2. Ultrasonic testing of materials/ H Krautkramer/Springer
3. Non destructive testing/Warren, J Mc Gonnagle / Godan and Breach Science publishers
4. Non destructive evaluation of materials by infrared thermography / X. P. V. Maldague, Springer-Verlag, 1st edition, (1993)

REFERENCE BOOKS:

1. Ultrasonic inspection training for NDT/ E. A. Gingel/Prometheus Press,
2. ASTM Standards, Vol 3.01, Metals and alloys
3. Non-destructive, Hand Book – R. Hamchand

Semester	VII	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEPE15
Name of the Course	Gas Dynamics and Jet Propulsion **Professional Elective – V**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the basic principles of Gas Dynamics.	K2
CO2	Apply governing equations of Isentropic Flow.	K3
CO3	Illustrate governing equations of Fanno Flow, Rayleigh Flow.	K3
CO4	Develop governing equations of Normal Shock.	K3
CO5	Examine jet engines, rocket engines and associated parameters.	K3

UNIT – I

Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity, mach number, classification of fluid flow based on mach number, mach cone, compressibility factor, general features of one dimensional flow of a compressible fluid, continuity and momentum equations for a control volume.

UNIT – II

Isentropic flow of an ideal gas: basic equation, stag nation enthalpy, temperature, pressure and density, acoustic speed, critical speed of sound, maximum fluid velocity, mach number M*, area ratio as function of mach number, dimensionless velocity, governing equations for isentropic flow of a perfect gas, critical flow area, stream thrust an dimpulse function.

Steady one dimensional is entropic flow with area change, effect of area change on flow parameters, chocking, convergent nozzle, performance of a nozzle under decreasing backpressure, De lavelnozzle, optimum area ratioeffect of back pressure, nozzle discharge coefficients, nozzle efficiencies.

UNIT – III

Simple frictional flow: adiabatic flow with friction in a constant area duct, governing equations, fanno line limiting conditions, effect of wall friction on flow properties in an Isothermal flow with friction in a constant are a duct, governing equations, limiting conditions.

Steady one dimensional flow with heat transfer in constant area duct, governing equations, Rayleigh line entropy change caused by heat transfer, conditions of maximum enthalpy and entropy.

UNIT – IV

Effect of heat transfer on flow parameters: Intersection of Fanno and Rayleigh lines, Shock waves in perfect gas, properties of flow across a normal shock, governing equations, Rankine Hugoniat equations, Prandtl's velocity relationship, converging diverging nozzle flow with shock thickness, shock strength.

UNIT – V

Propulsion: Air craft propulsion: types of jet engines, energy flow through jet engines, thrust, thrust power and propulsive efficiency, turbojet components - diffuser, compressor, combustion chamber, turbines, exhaust systems.

Performance of turbo propeller engines, ramjet and pulse jet, scram jet engines. Rocket propulsion-rocket engines, Basic theory of equations - thrust equation, effective jet velocity, specific impulse, rocket engine performance, solid and liquid propellant rockets, comparison of various propulsion systems.

TEXT BOOKS:

1. Compressible fluid flow/A.H.Shapiro/Ronald Press Co.,1953
2. Fundamentals of compressible flow with air craft and rocket propulsion / S.M.Yahya / New Age international Publishers
3. Fundamental of Gasdynamics-2nd edition/MJZucker/Wiley publishers

REFERENCE BOOKS:

1. Elements of gas dynamics/HW Liepman & ARoshko /Wiley
2. Air craft & Missile propulsion/MJ Zucrow/Wiley
3. Gas dynamics/M.J.Zucrow & Joe D.Holfman / Krieger Publishers

		L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEJO1
Name of the Course	CAD / CAM **Job Oriented Course**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the basics of CAD/CAM and different representations of curves	K2
CO2	Identify the basic components to solve different surface models	K2
CO3	Interpret the functionality of numerical control systems to write the programming	K3
CO4	Illustrate part families and group technology models	K3
CO5	Apply appropriate process strategy to achieve FMS	K3

UNIT – I

Fundamentals of CAD/ CAM, Application of computers for Design and Manufacturing, Benefits of CAD/ CAM - Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAM software- definition of system software and application software, CAD/ CAM database and structure.

Geometric Modeling: Wire frame modeling, wire frame entities, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT – II

Surface Modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parameterization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modeling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT – IV

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design. Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

Computer Aided Manufacturing Resource Planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacityrequirements planning

UNIT – V

Flexible Manufacturing System: F.M.S equipment, FMS layouts, Analysis methods for FMSbenefits of FMS.

Computer Aided Quality Control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM

TEXT BOOKS:

1. CAD/CAM Concepts and Applications/ Alavala / PHI
2. CAD/CAM Principles and Applications/P.N. Rao/Mc Graw Hill
3. CAD/CAM/ GrooverM.P/ Pearson
4. CAD/CAM/CIM/Radha Krishnan and Subramanian/New Age

		L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEJO2
Name of the Course	Refrigeration and Air conditioning **Job Oriented Course**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Apply the concept of refrigeration to various systems.	K3
CO2	Employ the methods to improve performance of vapor compression systems.	K3
CO3	Identify eco-friendly refrigerants and understanding various VCR System Components.	K2
CO4	Analyze cooling and heating loads in an air conditioning system.	K4
CO5	Explain various air conditioning systems.	K2

UNIT – I

INTRODUCTION TO REFRIGERATION: Necessity and applications – Unit of refrigeration and C.O.P. –Mechanical refrigeration – Types of ideal cycles of refrigeration.

Air refrigeration: Bell Coleman cycle - Open and Dense air systems – Refrigeration needs of Air crafts- Refrigeration systems used in air crafts and Problems.

UNIT – II

VAPOUR COMPRESSION REFRIGERATION: Working principle and essential components of the plant –simple vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – Effect of sub cooling and super heating – Cycle analysis – Actual cycle influence of various parameters on system performance – Use of p-h charts – Problems.

UNIT – III

Refrigerants – Classification – Desirable properties of an ideal refrigerant – Common refrigerants used – Nomenclature of refrigerants .

VCR System Components: Compressors – General classification – comparison – Advantages and Disadvantages. Condensers – Classification – Working Principles. Evaporators – Classification – Working Principles. Expansion devices – Types – Working Principles.

UNIT – IV

VAPOR ABSORPTION SYSTEM: Calculation of maximum COP – description and working of Water-Ammonia Systems, Water-Lithium Bromide System. Principle of operation three fluid absorption system, salient features.

INTRODUCTION TO AIR CONDITIONING: Psychometric properties & Processes – Characterization of sensible and latent heat loads — Need for ventilation, Consideration of infiltration – Load concepts of RSHF, GSHF- Problems, concept of ESHF and ADP temperature.

UNIT – V

AIR CONDITIONING SYSTEMS: Classification of equipment, Components related to Air-Conditioning Systems- filters, grills and registers, fans and blowers.

TEXT BOOKS:

1. A Course in Refrigeration and Air conditioning , SC Arora & Domkundwar, Dhanpatrai
2. Refrigeration and Air Conditioning , CP Arora, TMH.
3. Refrigeration and Air Conditioning / Manohar Prasad / New Age

REFERENCE BOOKS:

1. Principles of Refrigeration /Dossat / Pearson Education.
2. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / TMH
3. Stoecker, W. F., and Jones, J. W., Refrigeration and Air-Conditioning, McGraw - Hill, New Delhi.
4. Data Book: Refrigerant and Psychrometric Properties - Tables and Charts [SI Units], MathurM. L., and Mehta F. S., Jain Brothers.

		L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEJO3
Name of the Course	Integration of AI & ML in Mechanical Engineering **Job Oriented Course**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Apply ML models in design of mechanical materials	K3
CO2	Apply AI technologies for development of Robotics	K3
CO3	Apply AI to represent manufacturing problems	K3
CO4	Apply ML for engineering design	K3
CO5	Apply AI for thermal comfort systems	K3

UNIT – I

AI and ML in design of mechanical materials: Introduction – summary of ML models – data collection, generation and pre-processing – Applications – perspectives.

UNIT – II

Robotics and AI: Introduction – History – current state of the art – the seasons of AI and robotics – technologies and disciplines – limitations – weak and strong AI and robotics – the impact of government – major technological firms – programming languages – risks and fears

UNIT – III

Artificial intelligence in advanced manufacturing: Introduction to Artificial intelligence in advanced manufacturing – Evolution – Opportunities – Hierarchical approach to manufacturing systems – Manufacturing system optimization – AI for manufacturing applications of human robot collaboration – AI for condition based maintenance – AI for process monitoring, diagnostics and prognostics – AI for manufacturing process control – challenges and opportunities

UNIT – IV

Machine learning approach for engineering design: Introduction – model formation and use – Adaptive and interactive Modelling systems(AIMS) – Apply AIMS to engine design: engine design simulator, simulation and example generation – AIMS as support tool.

UNIT – V

AI for efficient thermal comfort systems: Introduction – thermal comfort: Air conditioning and personal thermal comfort system – AI for thermal comfort requirements – current applications and requirements of AI for thermal comfort in buildings – future directions for enabling autonomous personalized thermal comfort systems

TEXT BOOKS:

1. Artificial Intelligence: A Modern Approach, 4th US ed. by Stuart Russell and Peter Norvig
2. Artificial Intelligence Saroj Kaushik. February 19, 2018

REFERENCE JOURNAL PUBLICATIONS:

1. Kai Guo, Zhenze Yang, Chi-Hua Yu and Markus J. Buehler, "Artificial intelligence and machine learning in design of mechanical materials", *Mater. Horiz.*, 2021, 8, 1153–1172 | 1153–1172.
2. Estifanos Tilahun Mihret, "Robotics and Artificial Intelligence", International Journal of Artificial Intelligence and Machine Learning Volume 10 • Issue 2 • July-December 2020, pp. 57-78.
3. Jorge F. Arinez, Qing Chang, Robert X. Gao, Chengying Xu and Jianjing Zhang, "Artificial Intelligence in Advanced Manufacturing: Current Status and Future Outlook", Journal of Manufacturing Science and Engineering · NOVEMBER 2020, Vol. 142 / 111003-1 to 16.
4. Sudhakar Yerramareddy, David K. Tcheng, Stephen C-Y. Lu, and Dennis N. Assanis, "Cmatjng and Using Models for Engineering Design", Article in IEEE Expert · June 1992, pp. 52-59.
5. Ali Ghahramani, Parson Galicia, David Lehrer, Zubin Varghese, Zhe Wang and Yogesh Pandit, "Artificial Intelligence for Efficient Thermal Comfort Systems: Requirements, Current Applications and Future Directions", Front. Built Environ. 6:49. Volume 6, Article 49, April 2020, pp. 1-16.

		L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEJO4
Name of the Course	Industrial Safety and Management **Job Oriented Course**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the basic principles of Industrial Safety	K2
CO2	Discuss the principles of Directing for Safety	K2
CO3	Explain the principles of Safety Management	K2
CO4	Describe the role of Safety Committee	K2
CO5	Apply the knowledge for Accident Prevention	K3

UNIT – I

Henrichs Axioms Of Industrial Safety, Concepts Of Safety, Organization For Safety, Organization, Definition, Need & Principles Organizing For Health, and, Environmental, Activities, Organization Structure, Function & Responsibilities.

UNIT-II

Directing For Safety, Direction, Definition, Process, Principles and Techniques Leadership, Role, Function and, Attributes of a Leader.

UNIT-III

Safety Management System, Objectives of Health, Safety and Environment Policy, Responsibility for Implementation of HSE Policy.

UNIT-IV

Role of Occupier and Factory Manager, Factory Safety Committee, Structure and Functions and Working Tenure details etc.

UNIT-V

ACCIDENT PREVENTION :Definition : Incident, Accident, Injury , Dangerous occurrence ,Unsafe Act, Unsafe, Conditions, Hazards, Error, Oversight, Mistake ,Near Miss ,Electricity & Hazards ,Of Electricity, Explosives and Transportation Safety.

TEXT BOOKS:

1. Fundamentals of Industrial safety & health by K.U. Mistry.
2. Factories Act 1948.

		L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEJO5
Name of the Course	Industrial Hydraulics and Pneumatics **Job Oriented Course**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Identify the fundamentals of Fluid Power Systems found in industry today.	K2
CO2	Discuss various types of Fluid Power Actuators	K2
CO3	Illustrate various Hydraulic elements in the design of circuits	K3
CO4	Describe the operations of Accumulators & intensifiers typically used in industry.	K2
CO5	Illustrate various Pneumatic systems and their operations	K3

UNIT – I

Fundamentals of Fluid Power Systems – Introduction-types advantages, disadvantages & applications-fluid characteristics-terminologies used in fluid power-hydraulic symbols-hydraulic systems and components-sources pumping theory-gear, vane & piston pumps.

UNIT – II

Fluid Power Actuators: Introduction-hydraulic actuators-hydraulic cylinders types, construction, specifications and special types. Hydraulic motors working principle-selection criteria for various types-hydraulic motors in circuits

UNIT – III

Hydraulic elements in the design of circuits – Introduction-control elements direction control valve-check valve-pressure control valve-relief valve throttle valve-temperature & pressure compensation-locations of flow control valve.

UNIT – IV

Accumulators & intensifiers-types, size & function of accumulators application & circuits of accumulators – intensifiers – circuit & applications. Design & drawing of hydraulic circuits-Introduction-case study & specifications-method of drawing a hydraulic circuit-hydraulic cylinder – quick return of a hydraulic cylinder.

UNIT –V

Pneumatic systems-Introduction-symbols used-concepts & components comparison- types & specifications of compressors-arrangement of a complete pneumatic system-compressed air behaviour- understanding pneumatic circuits-direction control valves. Electro pneumatics- Introduction-Pilot operated solenoid valve-electrical connections to solenoids-electro pneumatic circuit switches-relays-solenoids- P.E converter-concept of latching.

TEXT BOOKS:

1.Introduction to Hydraulics and Pneumatics by S. Ilango and V. Soundararajan, PHI , New Delhi.
2.Applied hydraulics and pneumatics-T. Sunder Selwyn & R. Jayendiran, Anuradha Publications.

REFERENCE BOOKS:

1.Oil Hydraulic Systems, S.R .Majumdar, McGrawHill Companies.
2.Pneumatic Systems : Principles and Maintenance, Majumdar, Mc Graw Hill.

Semester	VI	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEJO6
Name of the Course	Automation in Manufacturing **Job Oriented Course**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Explain Automation and types of Automations in the industries.	K2
CO2	Examine different Automated flow lines in the Industries.	K3
CO3	Asses and perform one or more processing and/or assembly operations on a starting raw material, part, or set of parts.	K3
CO4	Produce a sequence of automated or mechanized assembly operations Flexible manufacturing system (FMS)—a highly automated machine cell that produces part.	K3
CO5	Interpret logic controls, sensor, actuators and software configuration	K2

UNIT – I

Introduction: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools, Mechanical Feeding and to changing and machine tool control transfer the automation

UNIT – II

Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration. Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines .

UNIT – III

Assembly system and line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT – IV

Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems. Automated storage systems: Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT – V

Fundamentals of Industrial controls: Review of control theory, logic controls, sensors and actuators, Data communication and LAN in manufacturing. Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.

TEXT BOOKS:

1. Automation, production systems and computer integrated manufacturing/ Mikell. P Groover
2. CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahamanyarn and Raju/New Age International Publishers
3. System Approach to Computer Integrated Design and Manufacturing/ Singh/John Wiley

REFERENCE BOOKS:

1. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/ Pearson
2. Manufacturing and Automation Technology / R Thomas Wright and Michael Berkeihiser / Good
Heart/Willcox Publishers

Annexure - II

Courses offered in OPEN ELECTIVES V, VI & VII Semester B.Tech., under V20 Regulations to the students of the other departments

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEOE1
Name of the Course	Basic Mechanical Engineering **Open Elective**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Discuss different types of materials, their properties and testing with applications.	K2
CO2	Interpret concepts of thermodynamics, Refrigeration, air conditioning and working of IC engines and air conditioners.	K2
CO3	Illustrate different manufacturing, joining, machining processes and machines with applications.	K2
CO4	Explain concepts of force, power transmission and power plants.	K2
CO5	Discuss the classification and working of pumps, turbines and gas turbines.	K2

UNIT – I

ENGINEERING MATERIALS AND PROCESSES:

ENGINEERING MATERIALS: Ferrous metals (Mild steel, Cast iron and its types, Stainless steel, High carbon steel), Non ferrous metals and alloys (Copper, Zinc, Aluminium, Tin, Nickel and their alloys). Properties- Strength, Hardness, Toughness, Brittleness, Creep, Fatigue, Stiffness, Ductility, Malleability, Elasticity, Plasticity, Specific gravity, Viscosity, Thermal conductivity, Specific heat, Corrosion resistance.

UNIT – II

THERMAL SCIENCE:

THERMODYNAMICS: System, Surroundings, Thermodynamic equilibrium, Property, State, Path, Process, Cyclic process, Work, Heat, Energy, Enthalpy, Entropy, Internal energy, Laws of thermodynamics (Description only), Scales of temperature.

IC ENGINES: Classification, Carnot, Otto, Diesel Cycles with P-V and T-S diagrams, 2 and 4 stroke C.I and S.I engines, working, Hybrid engines, Indicated power, Brake power, efficiencies.

REFRIGERATION AND AIRCONDITIONING: Refrigerant and its types with applications, Unit of refrigeration, COP, working of vapour compression refrigeration.

UNIT – III

MANUFACTURING SCIENCE: Basic description of manufacturing processes-Casting, Forging, Rolling, Extrusion, Hot and cold working processes with applications.

METAL JOINING PROCESSES: Basic description with sketches-Rivetting, Arc welding, Gas welding, Soldering and Brazing with applications.

UNIT – IV

FORCE AND POWER TRANSMISSION:

FORCE SYSTEM AND ANALYSIS: Concepts of- Laws of motion, Free body diagrams, Resultant force, Equilibrium, Friction, laws of friction, Stress, types of stress, Strain, Poisson's ratio, Elastic constants, Moment, Moment of inertia, centroid, Torque.

POWER TRANSMISSION: Description of working with sketches-Belt, Chain drives, Gear trains with applications, Single plate clutches. Basic concepts of hydraulic and pneumatic power transmission.

UNIT – V

PUMPS AND PRIME MOVERS:

PUMPS: Classification of pumps, Description and working of- Reciprocating and centrifugal pumps with applications, priming, Multistage pumps., Discharge and coefficient of discharge.

PRIME MOVERS: Classification of hydraulic turbines, steam turbines, description and working of Pelton wheel and governing. Types of gas turbines and working of gas turbines with applications.

TEXT BOOKS:

1. Thermal Engineering –Rajput RK, Laxmi publications.
2. Elements of Mechanical Engineering-Sadhu singh, S.chand publications.
3. Basic Mechanical Engineering –Pravin kumar, Pearson publications.
4. Elements of Mechanical Engineering-N.M. Bhatt and J.R.Mehta, Mahajan publishing house.

REFERENCE BOOKS:

1. Production Technology-P.C.Sharma
2. Thermal Engineering-PL Ballaney
3. Power Plant Engineering-Nagpal
4. Workshop Technology-Hajra choudhury

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEOE2
Name of the Course	Green Engineering Systems **Open Elective**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Illustrate the concept of Solar Radiation, Collection, Storage and Applications	K2
CO2	Discuss the construction and working of wind energy and bio-energy conversion systems.	K2
CO3	Describe the construction and working of Geothermal and Ocean Energy conversion systems.	K2
CO4	Illustrate the principles of environmental impact of current manufacturing practices.	K2
CO5	Discuss the features and benefits of green building materials and its applications.	K2

UNIT – I

INTRODUCTION: SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, instruments for measuring solar radiation and sun shine, Flat plate and concentrating collectors.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different Storage methods, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT – II

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, types of winds.

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, bio fuels, I.C. engine operation.

UNIT – III

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential in India.

OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT – IV

ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, zero waste manufacturing.

UNIT – V

GREEN BUILDINGS: Definition, features and benefits. Sustainable site selection and planning of buildings for maximum comfort. Environmental friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings.

TEXT BOOKS:

1. Sukhatme S.P. and J.K.Nayak, Solar Energy – Principles of Thermal Collection and Storage,TMH.
2. Khan B.H., Non-Conventional Energy Resources, Tata McGraw Hill, New Delhi, 2006.
3. Green Manufacturing Processes and Systems, Edited by J. Paulo Davim, Springer 2013.

REFERENCE BOOKS

1. Alternative Building Materials and Technologies / K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Ra.
2. Principles of Solar Energy / Frank Krieth & John F Kreider.
3. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa
5. Renewable Energy Technologies/ G.D Roy

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEOE3
Name of the Course	Computational Fluid Dynamics **Open Elective**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Apply techniques in the numerical solution of fluid equations	K3
CO2	Apply numerical modeling and its role in the field of heat transfer and fluid flow.	K3
CO3	Develop methodologies used in CFD	K3
CO4	Compare various discretization methods and solving methodologies.	K4
CO5	Apply skills in the actual implementation of CFD methods (e.g. boundary conditions, different numerical schemes etc., Finite element methods in the application of CFD analysis to real life engineering designs.	K3

UNIT – I

ELEMENTARY DETAILS IN NUMERICAL TECHNIQUES: Number system and errors, representation of integers, fractions, floating point arithmetic, loss of significance and error propagation, condition and instability, computational methods for error estimation, convergence of sequences.

UNIT – II

APPLIED NUMERICAL METHODS: Solution of a system of simultaneous linear algebraic equations, iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices.

EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier – stokes equations.

UNIT– III

Steady flow, dimensionless form of momentum and energy equations, stokes equation, conservative body force fields, stream function - vorticity formulation. Finite difference applications in heat conduction and convention – heat conduction, steady heat conduction in a rectangular geometry, transient eat conduction, finite difference application in convective heat transfer, closure.

UNIT – IV

Finite differences, discretization, consistency, stability, and fundamentals of fluid flow modelling: introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

UNIT – V

Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modelling, conservative property, the up wind scheme.

FINITEVOLUMEMETHOD: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.

TEXTBOOKS:

1. Numerical heat transfer and fluid flow/Suhas V.Patankar- Butter –worth Publishers.
2.Computational fluid dynamics – Basics with applications -John. D.Anderson /McGraw Hill.

REFERENCEBOOKS:

1. Computational Fluid Flow and Heat Transfer/Niyogi, Pearson Publications.
2. Fundamentals of Computational Fluid Dynamics–Tapan K.Sengupta / Universities Press.
3. Computational fluid dynamics, 3rd edition/Wendt/Springer publishers

Semester	V	L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEOE4
Name of the Course	Rapid Prototyping **Open Elective**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand virtual prototyping and testing of technology	K2
CO2	Construct CAD modelling for rapid prototyping	K3
CO3	Examine different types of process in rapid prototyping	K3
CO4	Explain Rapid Manufacturing errors	K2
CO5	Express the applications of rapid prototyping	K2

UNIT – I

Introduction: Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process.

UNIT – II

CAD Modelling and Data Processing for RP: CAD model preparation, Data interfacing: formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures; Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing, Tool path generation.

UNIT – III

RP Processes: Process Physics, Tooling, Process Analysis, Material and technological aspects, Applications, limitations and comparison of various rapid manufacturing processes. Photo polymerization (Stereo lithography (SL), Micro stereo lithography), Powder Bed Fusion (Selective laser Sintering (SLS), Electron Beam melting (EBM)), Extrusion-Based RP Systems (Fused Deposition Modelling (FDM)), 3D Printing, Sheet Lamination (Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC)), Beam Deposition (Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD)).

UNIT – IV

Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS.

UNIT – V

Application of Rapid Prototyping and Technology: Functional models, pattern for investment and Vacuum casting, medical models, Art models, Engineering analysis models.

REFERENCE BOOKS:

1. Rapid Prototyping: Principles and Applications in Manufacturing. Chua C.K., Leong K.F., Chu S. L., World Scientific.
2. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Gibson, Ian, Rosen, David, Stucker, Brent, Pearson
3. Rapid Prototyping: Principles and Applications in Manufacturing. Noorani R, John Wiley & Sons.
4. Rapid Prototyping and Engineering applications: A tool box for prototype development. Liou W.L., Liou F. W., CRC Press
5. Rapid Prototyping: Theory and practice. Kamrani A. K., Nasr E. A., Springer

		L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEOE5
Name of the Course	Computer Aided Design **Open Elective**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Explain the basic fundamentals of CAD tools	K2
CO2	Find the characteristics of curves, Representation and continuity requirements	K3
CO3	Illustrate the Geometric Transformations and demonstrate various types of surfaces and Representation.	K3
CO4	Differentiate between the methods of representing Solid Modelling**.**	K4
CO5	Apply the local and global properties for product development	K3

UNIT – I

CAD Introduction: Need of machine design, use of computer, computer fundamentals, computer aided design process, CAD configuration, and CAD tools, positive and negative points of CAD, CAD and CAM integration.

UNIT – II

DESIGN OF CURVES: Fundamental of Curve Design, Parametric Space of a Curve, Representation, Parametric cubic curve, Blending functions, Truncation, extension, and subdivision, composite curve: continuity requirements .

UNIT – III

GEOMETRIC TRANSFORMATIONS: Translation, Rotation, Scaling Symmetry and Reflection, Homogeneous Transformations. Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformation.

DESIGN OF SURFACES: Fundamental of Surface Design, Parametric Space of a Surface, Representation of a Surface patch, sixteen point form, Four Curve Form, Plane.

UNIT – IV

SOLID MODELLING: Solid Modelling fundamentals, topology and geometry. Geometric Modelling Method, Constructive Solid Geometry (CSG), Boundary Representation (Brep), Introduction to Wireframe, surface and solid modelling techniques. Introduction CAD data exchange format IGES, STEP

UNIT – V

GEOMETRIC PROPERTIES: Local and global properties of a curve, Local and global properties of a surface, Global properties of complex solids, Relational properties, intersections. Applications in Product Development and other areas.

REFERENCE BOOKS:

1. Geometric Modeling: Michael E. Mortenson, Third Edition, Industrial Press Inc.2006.
2. Mathematical Elements of Computer Graphics, Rogers and Adams, McGraw Hill. 1994
3. CAD CAM Theory and Prectice: I. Zeid, Tata-McGraw Hill, 2006
4. Computer-Aided Engineering Design, B Sahay and ASaxena, Springer, 2005.
5. Differential Geometry of Curves and Surfaces, Thomas F. Banchoff and Stephen T. Lovett, Thomas Banchoff-Stephen Lovett, 2010.
6. Computational Geometry for Design and Manufacture, I.D. Faux and M.J. Pratt, John Wiley, 1980.
7. Lectures on Classical Differential Geometry, Dirk J. Struick, Addison Wesley, 1980.

		L	T	P	C	Course Code
Regulation	V20	3	0	0	3	V20MEOE6
Name of the Course	Mechatronics **Open Elective**					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the elements of Mechatronics & levels and explain various types of sensors , transducers and Mechatronics design process	K2
CO2	Sketch and explain various types of solid state devices like Diode, BJT, MOSFET, etc.,	K3
CO3	Illustrate and explain basic principles of Hydraulic, pneumatic, electro hydraulic, electro hydraulic servo actuating systems.	K3
CO4	Illustrate and explain microprocessors, microcontrollers and PLC	K3
CO5	Sketch and explain System interfacing and data acquisition systems.	K3

UNIT – I

MECHATRONICS SYSTEMS – elements & levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement,velocity, force, acceleration, liquid flow, liquid level, temperature and light sensors.

UNIT– II

SOLID STATE ELECTRONIC DEVICES - PN junction diode, BJT, FET, Analog signal conditioning, operational amplifiers, filters.

UNIT– III

HYDRAULIC AND PNEUMATIC ACTUATING SYSTEMS - Fluid systems, Hydraulic systems, and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems.

UNIT– IV

DIGITAL ELECTRONICS AND SYSTEMS - Digital logic control, micro processors and micro controllers, programming, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT– V

SYSTEM AND INTERFACING AND DATA ACQUISITION – Data Acquisition Systems, Analog to Digital and Digital to Analog conversions; Digital Signal Processing.

TEXT BOOKS:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran, GK Vijaya Raghavan & MS Balasundaram/WILEY India Edition

REFERENCE BOOKS:

1. Mechatronics /Smaili A, Mrad F/ Oxford Higher Education, Oxford University Press
2. Mechatronics Source Book / Newton C Braga/Thomson Publications, Chennai.
3. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
4. Mechatronics System Design / Devdas shetty/Richard/Thomson.
5. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
6. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition / W. Bolton / Pearson, 2012
7. Mechatronics – Principles and Application / Godfrey C. Onwubolu/Elsevier, Indian print

ANNEXURE- III

Sri Vasavi Engineering College (Autonomous)

(Sponsored by Sri Vasavi Educational Society)

(Approved by AICTE, New Delhi & Permanently affiliated to JNTUK, Kakinada)
(Accredited by NBA & NAAC with 'A' Grade, Recognized by UGC Under Section 2(f) & 12(B))

Pedatadepalli, Tadepalligudem, W.G.Dt, A.P-534101

Department of Mechanical Engineering

List of courses for B.Tech., - Honours Degree

S.No	Name of the course	No. of weeks	Credits	
1.	Advanced Machining processes	8	3	Students have to acquire a minimum of 14 credits by completing MOOCS/NPTEL courses from this pool
2.	Advanced materials and processes	12	4	
3.	Advanced thermodynamics and combustion	12	4	
4.	Advanced Engineering Thermodynamics	12	4	
5.	Advances in welding and joining technologies	8	3	
6.	Computational Fluid Dynamics and Heat transfer	12	4	
7.	Automation in production systems and management	12	4	
8.	Aluminium based alloys and metal matrix composites	12	4	
9.	Advanced fluid mechanics	12	4	
10.	BioMEMS and Microfluidics	8	3	
11.	Engineering Fracture Mechanics	12	4	
12.	Dynamics and Control of Mechanical Systems	12	4	
13.	Mechanism And Robot Kinematics	8	3	
14.	Welding Application Technology	8	3	
	Project work		**6**	
Total Credits		**20**		

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Pedatadepalli, Tadepalligudem, W.G.Dt, A.P-534101

Department of Mechanical Engineering

Minor degree in Mechanical Engineering

List of courses for B.Tech., (Minors) - 3D printing

S.No	Name of the course	No. opf weeks	Credits	
1.	Laser Based Manufacturing	8	3	Students have to acquire a minimum of 14 credits by completing MOOCS/NPTEL courses from this pool
2.	Fundamentals of additive manufacturing Technologies	12	4	
3.	Metal Additive Manufacturing	12	4	
4.	Rapid Manufacturing	12	4	
5.	The Future of Manufacturing Business: Role of Digital Technologies	8	3	
6.	Design for additive manufacturing	12	4	
7.	Additive Manufacturing Architecture	12	4	
8.	3D Printing	8	3	
9.	Additive Manufacturing for innovative design and production	12	4	
10.	Additive manufacturing- process and applications	12	4	
	Project work		**6**	
Total Credits		**20**		