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

COURSE STRUCTURE AND SYLLABUS

For

V & VI Semesters (V20 Regulation)

B.Tech. MECHANICAL ENGINEERING

(Applicable for batches admitted from 2020-2021)

DEPARTMENT OF MECHANICAL ENGINEERING (Accredited by NBA)

SRI VASAVI ENGINEERING COLLEGE (Autonomous)

PEDATADEPALLI, TADEPALLIGUDEM – 534 101

DEPARTMENT OF MECHANICAL ENGINEERING

Course structure 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*		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

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

Syllabi for the courses offered in V semester B. Tech under V20 Regulation

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		2+2	-	MNC	V20ENT04
Name of the Course	Professional Communication Skills - III					
Branch	Mechanical Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Distinguish the subtle meanings of various words in different contexts, recognize similar words as well as words with contrast meanings and use them appropriately. Express writer's tone and relevant ideas using different types of writing skills and prepare resume to showcase skills and accomplishments. Organize thoughts in the discussions and express views without reticence. Develop the ability to write different types of essays in a structured way, maintaining cohesion and logic	K4
CO2	Identify the central theme and arrange the scrambled sentences into a meaningful passage. Draft emails with appropriate subject-lines and relevant content. Compare different pairs of words, recognize the relationship between the head words and the options to siphon correct analogy Choose an appropriate word to make a sentence meaningful. Infer the meaning of the picture by thinking out of the box and speak without inhibitions and face interviews with aplomb.	K2
CO3	Analyze appropriate methods of logical thinking on Ratio and Proportion, Partnership, LCM and HCF, Number System, Areas & Volumes.	K4
CO4	Demonstrate problem solving skills through the concepts of Percentages, Profit and loss, Simple Interest & Compound Interest and Allegation.	K3
CO5	Calculate the end results of Cubes, Dice and Data Analysis, Time & Work, Time & Distance, Race & Games.	K4

UNIT – I

VOCABULARY – MODEL RESUMES & SPEAKING

500 words (PIC-VOC) -Meaning – contextual Usage - Prefix – Suffix – Root words. Resume writing-Model Resume-Introducing different formats-Tailoring resume as per job description. Paragraph writing- Essay writing- Types of Essays- Strategies – Cause and effect signals – support signals – contrast signals. Watch a video and respond
Group Discussion – Types of GD – Dos & Don'ts , JAM , Presentation Skills, Designing Advertisements

UNIT – II

GRAMMAR, WRITING & SPEAKING SKILLS

Tenses – Simple – Continuous – perfect – perfect continuous - voice – Active & Passive -Para jumbles – Strategies – Directional words – central theme-Email writing– Types -- Dos and Don'ts- **VERBAL ABILITY- ANALOGIES- INTERVIEW SKILLS- CREATIVE**

THINKING

ANALOGIES: Strategies - Recognize common relationship types. Synonyms – Antonyms - Create a general sentence - Use the correct part of speech - Beware of homonyms.Equalizing the sentences- scrambled sentences. Interview Skills – Personal Interview – Skype Interview – Telephone Interview – Mock Interviews. Creative thinking – Picture Interpretation -Creative writing

UNIT – III

Ratio & Proportion, Partnership, LCM & HCF and Areas & Volumes

Introducing the concept of ratio in three different methods, a method to compute and compare two ratios – The effect of increase or decrease of a quantity on the ratio – The meaning of proportion and Problems related to Ratio and Proportion. Improve problem solving skills through Lcm & Hcf.

UNIT - IV

Percentages, Profit and Loss, Simple and Compound Interest, Allegation & Mixtures

Definition of Simple and Compound Interest. Formulas of Applications – Difference between Simple and Compound interest – Rate of Increase or Decrease Population – Expected values of Maturity. Calculate percentages on different situations, using in profit and loss. Identifying difference between Cost price, Selling Price and Marked Price, Finding Discounts, using the method of allegation.

UNIT – V

Time, Work and Distance, Cubes, Dice and Data Analysis

Men- Days -work –completion- Capability Ratio among Men, Women and Children – Application of time in Pipes and Cistern. Work Progress in positive and negative effects. Relation among Time, Speed and Distance – Concepts of Relative speed and Average Speed – Ideas about Boats and Streams and Races of Games. Calculate the end results of Cubes and Dice.

References

- Dr.Sujani Tata et al., Pic Voc (2015) – Published by Sri Vasavi Engineering College
- Lewis Norman, Word Power Made Easy (2008). Goyal Publishers & Distributors Pvt. Ltd.
- Dr.Shalini Verma, Reetesh Anand, Word Power Made Handy(2017). S Chand Publications.
- R S Aggarwal,Objective General English (2017). S Chand Publications.
- Sunita Mishra & C.Muralikrishna, Communication Skills for Engineers (2006). Dorling Kindersley (India) Pvt. Ltd., licensees of Pearson Education in South Asia.
- Charles W Hanson. Resume: Writing 2020 The Ultimate Guide to Writing a Resume that Lands YOU the Job! (2019).
- Raymond Murphy. Essential Grammar in Use (1985).Cambridge University Press
- Seely John. The Oxford Guide to Writing & Speaking (2004). Oxford University Press.
- Jain,T.S. & Gupta. , 2010, Interviews and Group Discussions, Upkar's Publications.
- Training & Placement cell, 2020, Workbook -1 on Aptitude, Sri Vasavi Engineering College.
- M Tyra, 2013, Magical Book on Quicker maths, BSC Publications.
- K Kundan & M Tyra, 2009, Practice Book on Quicker Maths, BSC Publications.

- Dr. RS. Agarwal , 2017, Quantitative Aptitude, Sultan Chand Publications
- Dr. RS. Agarwal, 2017, A modern approach to verbal & on verbal reasoning, Sultan Chand Publications.

Web References:

- https://www.indiabix.com/
- https://www.campusgate.co.in/
- https://www.questionpaper.org/

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

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	V20MAT08
Name of the Course	Operations Research					
Branch						

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Understand the formulating of LPP and solve LPP by Simplex methods, artificial variables techniques.	K2
CO2	Solve Transportation and assignment problems.	K3
CO3	Explain the concept of Sequencing and replacement of item.	K2
CO4	Apply the principles of game theory to real world competitive situations	K3
CO5	Understand the concept of queues with single server,	K2

UNIT – I **(10 hrs)**

HISTORICAL OVERVIEW – Definition and scope– types of operation research models – applications.

LINEAR PROGRAMMING: Problem formulation – graphical solution – simplex method – artificial variables techniques - big-M method.

UNIT – II **(10 hrs)**

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – degeneracy

ASSIGNMENT PROBLEM: Introduction, optimal solution, Traveling Salesman problem.

UNIT – III **(9 hrs)**

SEQUENCING – Introduction – flow –shop sequencing – *n* jobs through two machines – *n* jobs through three machines

REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement

UNIT – IV **(10 hrs)**

THEORY OF GAMES: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

UNIT – V **(9 hrs)**

WAITING LINES: Introduction – single channel – poison arrivals – exponential service times – with infinite population and finite population models

TEXT BOOKS:

1. Operations Research / S.D.Sharma-Kedarnath
2. Operations Research by R. Pannerselvam; Publisher: Prentice Hall International.

REFERENCES:

1. Introduction to O.R/Hiller & Libermann (TMH).
2. Operations Research / A.M.Natarajan, P. Balasubramani, A. Tamilarasi / Pearson Education.
3. Operations Research: Methods & Problems / Maurice Saseini, Arhur Yaspan & Lawrence Friedman.

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	2	0	0	0	V20CEMC01
Name of the Course	Intellectual Property Rights and Patents					
Branch	Civil Engineering					

Course Outcomes:

	After successful completion of the course, the student will be able to:	Knowledge Level
CO1	Describe the need of Intellectual Property Rights	K2
CO2	Generalize different issues regarding Copy Rights	K2
CO3	Employ the procedure for Patent registration and granting	K3
CO4	Explain the importance of Trademark and its related issues	K2
CO5	Recognize in significance of Trade Secrets in Industry	K2

UNIT – I

Introduction to Intellectual Property Rights (IPR): Introduction to IPR, Evolutionary Past, Concept of IPR – Purpose of IPR, Types of IPR, WIPO -TRIPS, Nature of IPR, Patents, Trademarks, Copyrights, Neighboring Rights, Agencies responsible for IPR - Infringement,Use and Misuse of Intellectual Property Rights.

UNIT – II

Copyrights: Introduction to Copyrights – Principles of Copyright Protection – Law Relating toCopyrights - Copyright Ownership – Transfer and Duration – Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Semiconductor Chip Protection Act.

UNIT – III

Patents: Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Registration and Granting of Patent -Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing – Software Protection and Computer related Innovations.

UNIT – IV

Trademarks: Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – – Trade Mark Registration – Trade Mark Maintenance – Transfer of rights – Deceptive Similarities - Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

UNIT – V

Trade Secrets: Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets - Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law, Cyber Law and Cyber Crime

TEXT BOOKS:

1. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. OxfordUniversity Press, New Delhi.
2. PrabhuddhaGanguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
3. R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books.New Delhi.

REFERENCE BOOKS:

1. Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.
2. Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
3. Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S.Publications (Press).
4. Cyber Law - Texts & Cases, South-Western's Special Topics Collections.
5. M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

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.