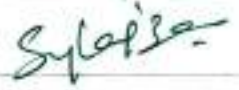
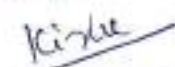
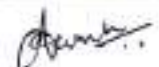
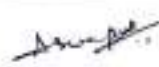
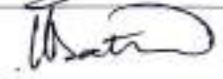
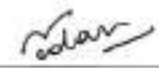




VIDYA JYOTHI INSTITUTE OF TECHNOLOGY
An Autonomous Institution
Aziznagar Gate, C.B. Post, Hyderabad - 500 075, Telangana.

Minutes of the Board of studies (Mech) meeting for R22 regulation for B.Tech II Year held online on 29th March 2023 at 10.00 AM.

The following members were present,

S.No	Name of the Member	Designation	Signature
1.	Dr. G. Sreeram Reddy	Chairman	
2.	Dr.M.Shailaja	JNTUH, Nominee	
3.	Dr. K. Kishore	Member	
4.	Dr. K. Sudhakar Reddy	Member	
5.	Dr. C. Udaya Kiran	Member	
6.	Mr. Ayush Nadimpalli	Member	
7.	Ms. A. Swapnika	Member	
8.	Dr. B.V. Reddi	Member	
9.	Dr. V.V.Satyanarayana	Member	
10.	Dr. L. Madan Ananda Kumar	Member	
11.	Dr. B. Ravinder Reddy	Member	

Item No. 1: Approval of R22 B.Tech 2nd Year I & II Semesters Syllabi

- a) The Chairperson presented the syllabi of the following subjects of B.Tech II Year I Semester viz.
1. Metallurgy & Material Science
 2. Mechanics of Solids
 3. Thermodynamics
 4. Production Technology
 5. Computer Aided Machine Drawing
 6. Material Science & Mechanics of Solids Laboratory
 7. Production Technology Lab
- b) The Chairperson presented the syllabi of the following subjects of B.Tech II Year II Semester viz.
1. Kinematics of Machinery
 2. IC Engines & Gas Turbines
 3. Fluid Mechanics & Hydraulic Machines
 4. Instrumentation and Control Systems.
 5. Fluid Mechanics & Hydraulic Machines Laboratory.
 6. Instrumentation Laboratory
 7. Real-time Research Project/ Field-Based Project.

Item No. 2: Approval of Substitute subjects for the students with Regulation change

The Chairperson emphasized the necessity of change of subjects for the students with Regulation change. He may take appropriate measures to offer required subjects to fulfill the number of credits. Students detained and readmitted shall study the subjects in the corresponding semester. The student shall also study the substitute and additional subjects as per the list furnished below.

- a) The Chairperson presented the subjects of B.Tech I Year I Semester to IV Year II semester for the students admitted with R18 regulation and readmitted after detention.

Year/Semester	Substitute Subjects	Additional subjects	Credit
I/I	Engineering Graphics & Modelling	-	2.5
I/II	Engineering Workshop	-	2.5
II/I	-	-	-
II/II	-	-	-
III/I	-	-	-
III/II	*P.E-2	-	3
IV/I	*P.E-3	-	3
IV/II	-	-	-

* Professional Elective (P.E-2): Production and operations management deleted and Industrial Management included.

*Professional Elective (P.E-3): Industrial Management deleted and Production and operations management included.



Sylabi

San B. H. H.



Kirke

K-2

- b) The Chairperson presented the subjects of B.Tech I Year I Semester to IV Year II semester for the students admitted with R19 regulation and readmitted after detention.

Year/Semester	Substitute Subjects	Additional Subjects	Credit
I/I	-	-	-
I/II	-	-	-
II/I	-	-	-
II/II	-	-	-
III/I	1. Metrology and Machine Tools	-	3
	2. PE-1*		3
	3. Thermal Engineering and Metrology & Machine Tools Lab		1
	4. Personality Development and Behavioral Skills		1
III/II	1. Managerial Economics and Financial Analysis	Computer Aided Engineering Lab	3
	2. OE-2*		3
	3. Quantitative Methods & Logical Reasoning		1
IV/I	-	-	-
IV/II	-	-	-

*Professional Elective (P.E-1): Composite Materials deleted and Mechatronics included.

*Open Elective (O.E-2): Optimization Techniques deleted and Principles of Operation Research included.

- c) The Chairperson presented the subjects of B.Tech I Year I Semester to IV Year II semester for the students admitted with R20 regulation and readmitted after detention.

Year/Semester	Substitute subjects	Additional subjects	credit
I/I	-	-	-
I/II	-	-	-
II/I	-	-	-
II/II	-	-	-
III/I	-	-	-
III/II	OE-2*	-	3
IV/I	-	-	-
IV/II	-	-	-

**Open Elective (O.E-2): Principles of Operation Research deleted and included Industrial Engineering included

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Angu *Bo* *Vide*

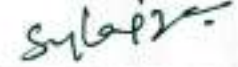
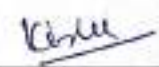
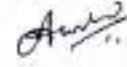
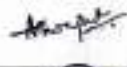
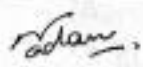
After discussing various aspects of the syllabi the committee passed the following resolution.

Resolution (1): To approve the Panel of examiners and adding new Courses

The Chairman BOS is authorized to incorporate new subjects in Professional electives as per the need and he is also authorized to give panel of Examiners for setting Question papers and evaluating the Answer scripts.

Noted and Approved.

Signatures of the Members Present:

S.No	Name of the Member	Designation	Signature
1.	Dr. G. Sreeram Reddy	Chairman	
2.	Dr.M.Shailaja	JNTUH Nominee	
3.	Dr. K. Kishore	Member	
4.	Dr. K. Sudhakar Reddy	Member	
5.	Dr. C. Udaya Kiran	Member	
6.	Mr. Ayush Nadimpalli	Member	
7.	Ms. A. Swapnika	Member	
8.	Dr. B.V. Reddi	Member	
9.	Dr. V.V.Satyanarayana	Member	
10.	Dr. L. Madan Ananda Kumar	Member	
11.	Dr. B. Ravinder Reddy	Member	



VIDYA JYOTHI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

(Accredited by NAAC & NBA, Approved by AICTE New Delhi & Permanently Affiliated to JNTUH)

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.		Probability & Statistics	3	1	0	4
2.		Mechanics of Solids	3	0	0	3
3.		Metallurgy & Material Science	3	0	0	3
4.		Production Technology	3	0	0	3
5.		Thermodynamics	3	1	0	3
6.		Production Technology Laboratory	0	0	2	1
7.		Material Science & Mechanics of Solids Laboratory	0	0	2	1
8.		Computer Aided Machine Drawing	1	0	2	1
9.		Professional Communications	2	0	0	1
Total Credits			18	2	6	20

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VIDYA JYOTHI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

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II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.		Basic Electrical and Electronics Engineering	3	0	0	3
2.		Kinematics of Machinery	3	0	0	3
3.		Fluid Mechanics & Hydraulic Machines	3	0	0	3
4.		IC Engines & Gas Turbines	3	0	0	3
5.		Instrumentation and Control Systems	3	0	0	3
6.		Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
7.		Fluid Mechanics & Hydraulic Machines Laboratory	0	0	2	1
8.		Instrumentation Laboratory	0	0	2	1
9.		Real-time Research Project/ Field-Based Project	0	0	4	2
10.		Quantitative Methods & Logical Reasoning	2	0	0	0
Total Credits			17	0	10	20

1.

Sharma

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MECHANICS OF SOLIDS

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

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

1. Understand the internal forces, moments, stresses, strains, and deformations in structures made of various materials acted on by a variety of loads.
2. Appreciate the concepts of shear force and bending moments. Generate shear force and bending moment diagrams for any given beam problem.
3. Develop the bending formula and apply to the design of beams.
4. Applying the theories of elastic failure for structure under consideration and evaluating principal stresses and strains.
5. Analyzing the failure of shafts under the torsional forces.

UNIT – I: Simple Stresses & Strains

Elasticity and plasticity – Types of stresses & strains–Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience

UNIT – II: Shear Force and Bending Moment

Definition of beam – Types of beams – Concept of shear force and bending moment –S.F and B.M diagrams for cantilever, simply supported and single overhanging beams subjected to point loads, UDL, Point of contra flexure

UNIT – III:

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, sections.

Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular sections.

UNIT – IV:

Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses – Principal stresses and strains – Analytical and graphical solutions.

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UNIT - V:

Columns and Struts: Euler's Theory, Limitations of Euler's theory, Equivalent Length, Rankine's Formula.

1. S. S. Rattan, "Strength of Materials", Second Edition Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2011

1. Barry J. Goodno and James M. Gere, "Mechanics of Materials" Ninth Edition, CengageLearning, 2018.
2. U. C. Jindal, "Strength of Materials", Pearson Education India, 2012
3. Egor P. Popov, Toader A. Balan, "Engineering Mechanics of Solids", PHI Learning 2010
4. G. H. Ryder, "Strength of Materials", Macmillan Long Man Publications, 1961
5. W. A. Nash and M. C. Potter, "Strength of Materials", Fifth Edition, Schaum's Outline Series, 2011

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- Top left: A signature.
- Top center: A vertical line with a horizontal crossbar and a small dot below it.
- Top right: The word "Sylvia" written in cursive.
- Bottom left: The word "Dan" written in cursive.
- Bottom center: The word "Dan" written in cursive, with a horizontal line underneath it.
- Bottom right: The word "Korin" written in cursive, with a horizontal line underneath it.

METALLURGY & MATERIAL SCIENCE

B.Tech. II Year I Sem

L	T	P	C
3	0	0	3

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

1. Understand the types of Crystal structures and their defects.
2. Comprehend the basic concepts of phase transformation during solidification employing phase diagrams.
3. Demonstrate importance of critical understanding of heat treatment in achieving required properties.
4. Apply the knowledge of heat treatment to enhance surface properties.
5. Analyze the properties and micro structure of ferrous and non-ferrous alloys.

UNIT – I

Structure of Metals: Crystal structures- BCC, FCC, HCP. Imperfection in solids: Point, line, surface and volume defects.

Mechanical behavior of Materials: Strengthening mechanisms, slip systems, critical resolved shear stress.

UNIT – II

Phase diagrams: Necessity of alloying, Hume – Rothery rules, substitutional and interstitial solid solutions. Interpretation of binary phase diagrams, eutectic, peritectic, eutectoid, peritectoid and monotectic reactions.

Iron Iron-carbide phase diagram: Detailed study of Iron Iron-carbide phase diagram and microstructural aspects of austenite, ledeburite, pearlite, ferrite and cementite.

UNIT – III

Heat treatment of steels: Isothermal transformation diagrams for Fe-C alloys and microstructures development. Martensite, Bainite. Annealing, Normalizing, Hardening, Tempering.

UNIT – IV

Continuous cooling curves: Continuous cooling curves and interpretation of final microstructures and properties-Thermo mechanical treatments like austempering, martempering.

Surface hardening methods: case hardening, carburizing, nitriding, carbonitriding, flame and induction hardening.

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UNIT – V

Ferrous Alloys: Alloy steels, properties and applications of stainless steels and tool steels, maraging steels- Types of cast irons (grey, white, malleable and spheroidal graphite cast irons).

Non-Ferrous Alloys: Copper and its alloys (Brass and bronze)- Aluminium and its alloys (Al-Cu Alloys).

TEXT BOOKS:

1. Sidney H Avner, Introduction to Physical Metallurgy, McGraw Hill, 2017

REFERENCE BOOKS:

1. V. Raghavan, "Material Science and Engineering", Prentice Hall of India Private Limited, Fifth Edition.
2. William. D. Callister, David G. Rethwisch, "Materials Science and Engineering: An Introduction", John Wiley & Sons, 2018.
3. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 9th Edition, Indian Reprint, 2009.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

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PRODUCTION TECHNOLOGY

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course Outcomes: Student will be able to:

1. Understand the basic concepts of casting processes to make different engineering components of industrial applications.
2. Identify the importance of permanent joining and principle behind different welding processes.
3. Evaluating the welded components for their defects using destructive and non-destructive testing methods.
4. Distinguish the hot working and cold working processes and recognize the processes of various rolling operations.
5. Elaborates the uniqueness of extrusion and forging processes in metal working.

UNIT – I:

Casting: Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances; Properties of moulding methods. Methods of Melting - Crucible melting and cupola operation – Defects in castings.

UNIT – II:

Welding: Classification – Types of welds and welded joints and their characteristics, Welding Positions - Gas welding - Types, Arc welding, Shielded metal arc welding, submerged arc welding, Resistance welding,

UNIT – III:

Inert Gas Welding _ TIG Welding, MIG welding, Friction welding, Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

UNIT – IV:

Hot working, cold working, recovery, recrystallisation and grain growth. Sheet metal Operations: Stamping, Blanking and piercing, Coining, Hot and cold spinning. Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements. Drawing and its types – wire drawing and Tube drawing.

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Bottom left: *Adarsh*, *Solanki*, *BK*
Center: A diagram of a vertical rod with a cross-section showing internal structure.
Bottom right: *Kirish*, *Sybil*, *BK*

UNIT – V:

Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion - Impact extrusion - Extruding equipment - Tube extrusion, Hydrostatic extrusion. Forces in extrusion.

Forging Processes: Forging methods - Smith forging, Drop Forging, Rotary forging - forging defects.

TEXT BOOKS:

1. Manufacturing Technology / P.N. Rao/ Vol.1 / Mc Graw Hill Education/ 5th Edition, 2018.

REFERENCE BOOKS:

1. Manufacturing Engineering & Technology / Serope Kalpakjian / Steven R. Schmid / Pearson, 7th Edition, 2014
2. Production Technology Vol.: 1, WILEY, sreeramulu M, 2018
3. A Text book of Production Technology (Manufacturing Processes)/ Dr.P.C. Sharma / S.Chand Publications /1st Edition, 2006.
4. Manufacturing processes H. S. Shan, Second Edition, Cambridge University Press, 2017.
5. Production Technology: Manufacturing Processes, Technology and Automation / R. K. Jain/Vol.1/Khanna Publishers /19th Edition, 2009.
6. Elements of Workshop Technology/ S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy/Vol.1/ Media Publishers & Promoters Pvt. Ltd./1st Edition, 2008.

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- Below it: "Sadan" and "B.M."
- Bottom left: "Chand" and "K.C."
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- Right: "Sylajee" written above a large, complex signature.
- Bottom right: "Kishu" written below the signature.

THERMODYNAMICS

B.Tech. II Year I Sem.

L	T	P	C
3	1	0	3

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

1. Understand the basics of Thermodynamics
2. Apply first and second laws of thermodynamics to different systems
3. Appreciate the concepts of phase transformation of pure substance.
4. Analyze mixtures of perfect gases and understanding the concepts of perfect gas laws.
5. Evaluate the performance of power cycles

Tables/Codes: Use of Steam Tables and Mollier Chart are permitted for the examination

UNIT – I:

Introduction: Basic Concepts: System, Control Volume Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

UNIT – II:

First Law of Thermodynamics: PMM I - Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation.

Second Law of Thermodynamics: Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase.

UNIT – III:

Pure Substances: p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts.

Water *1/2* *Sybil* *1/2* *1/2*
Solar *BK* *1/2* *1/2* *1/2*

UNIT – IV:

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes

Mixtures of perfect Gases – Mole Fraction, Mass fraction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.

UNIT – V:

Power Cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T–S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis

TEXT BOOKS:

1. Engineering Thermodynamics / PK Nag / Mc Graw Hill

REFERENCE BOOKS:

1. Thermodynamics – An Engineering Approach by Yunus A. Cengel & Michael A. Boles, TMH
2. Fundamentals of Classical Thermodynamics by G. Van Wylen & R.E. Sonntag, John Wiley Pub
3. Engineering Thermodynamics by Jones & Dugan, PHI, 2007.
4. Thermodynamics by M. Achutan, PHI, 2nd Edition, 2013.
5. Thermodynamics & Heat Engines by R. Yadav, Central Book Depot, Allahabad.
6. Thermodynamics by S.C. Gupta, Pearson Publications.

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A signature in blue ink at the bottom right.
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PRODUCTION TECHNOLOGY LABORATORY
(A223383)

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Outcomes: After completion of the course, the student will be able to

1. Understand the operating methods of moulding, casting, welding and mechanical press tools.
2. Measuring the properties of moulding sand.
3. Evaluate the quality of welded joints and products made by mechanical press.

Minimum of 10 Exercises need to be performed

I. Metal Casting Lab:

1. Pattern Design and making - for one casting drawing.
2. Sand properties testing for strengths.
3. Sand properties testing for permeability
4. Moulding of solid pattern and subsequent casting using molten aluminum.
5. Moulding of split-piece pattern by designing the elements of gating system.

II. Welding Lab:

1. Spot Welding
2. Brazing
3. Gas welding

III. Mechanical Press Working:

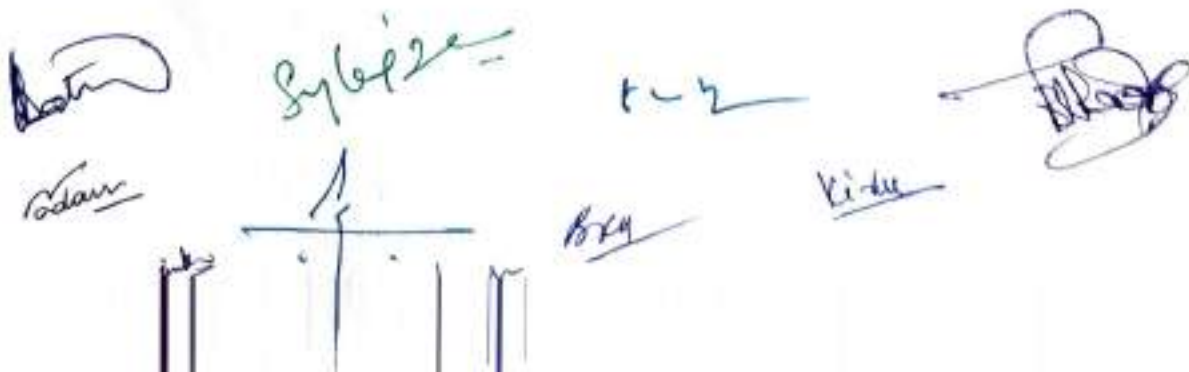
1. Blanking & Piercing operation and study of compound die press tool.
2. Bending and other operations

IV. Processing of Plastics

1. Injection Moulding

REFERENCE BOOK:

1. Dictionary of Mechanical Engineering – G.H.F. Naylor, Jaico Publishing House



MATERIAL SCIENCE & MECHANICS OF SOLIDS LABORATORY
(AA223384)

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

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

1. Understand and identify microstructure of metals and measure their mechanical properties.
2. Analyze the microstructure and mechanical properties of metals by applying metallurgical principles.
3. Evaluate the hardness and mechanical properties of treated and untreated steels.

MATERIAL SCIENCE

List of Experiments:

1. Preparation and study of the Microstructure of pure metals like iron, Cu and Al.
2. Preparation and study of the Microstructure of Mild steel, low carbon steels, high Carbon steels.
3. Study of the Microstructure of Cast irons.
4. Study of the Microstructure of Non-Ferrous alloys.
5. Study of the Microstructure of Heat treated steels.
6. Hardenability of steels by Jominy End Quench test.
7. To find out the hardness of various treated and untreated steels.

MECHANICS OF SOLIDS LAB:

List of Experiments:

1. Direct tension test
2. Bending test on Simple supported beam
3. Bending test on Cantilever beam
4. Torsion test
5. Brinell hardness test/ Rockwell hardness test
6. Test on springs
7. Izod Impact test/ Charpy Impact test

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COMPUTER AIDED MACHINE DRAWING

B.Tech. II Year I Sem.

L	T	P	C
1	0	2	1

Course Outcomes:

1. Prepare the engineering drawings by employing conventional representation.
2. Develop the assembly drawings using part drawings of machine components.
3. Applying the drawing practice using solid works software

Drawing of Machine Elements and simple parts

Selection of Views, additional views for the following machine elements and parts with every drawing proportion.

1. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
2. Keys, cottered joints and knuckle joint.
3. Rivetted joints
4. Shaft coupling, spigot and socket pipe joint.
5. Journal, pivot and collar and foot step bearings.

Drawing of Machine Elements: Using Computer aided drafting in addition to manual drawing

Assembly Drawings:

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

1. Machine tool parts: Tail stock, Tool Post, Machine Vices.
2. Other machine parts - Screw jack, Connecting rod, Plumber block.
3. Valves - Steam stop valve, spring loaded safety valve.
4. Miscellaneous: Eccentric, Stuffing Box

Assembly Drawings: Using Computer aided drafting in addition to manual drawing

NOTE: 1. First angle projection to be adopted.

TEXT BOOKS:

1. Machine Drawing / N.D. Bhatt / Charotar

REFERENCE BOOKS:

1. Machine Drawing with Auto CAD / Goutham Pohit, Goutam Ghosh / Pearson
2. Machine Drawing by / Bhattacharyya / Oxford
3. Machine Drawing / Ajeet Singh / Mc Graw Hill

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KINEMATICS OF MACHINERY

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

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

1. Understand working principles of different lower and higher pairs, mechanisms and their inversions.
2. Draw the velocity and acceleration polygons to compute their magnitude.
3. Understanding various steering gear mechanisms and Hooke's joint.
4. Appreciate different cams and followers used in mechanical systems.
5. Evaluating the number of teeth and velocity ratio required in gearing systems.

UNIT – I:

Mechanisms: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained.

Mechanism and Machines – Mobility of Mechanisms: Grubler's criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains.

UNIT – II:

Kinematics: Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method.

Plane motion of body: Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.

Analysis of Mechanisms: Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

UNIT – III:

Straight-line motion mechanisms: Tchebicheff's and Robert Mechanism – Pantographs

Steering gears: Conditions for correct steering – Davis Steering gear, Ackerman's steering gear.

Hooke's Joint: Single and double Hooke's joint – velocity ratio – application – problems.

Handwritten signatures and notes:
Babu
Sadan
BHU
Hitesh
Kishu
Sudip
Babu
Kishu

UNIT – IV:

Cams: Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

UNIT – V:

Higher pair: Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding.

Gear Trains: Introduction – Types – Simple – compound and reverted gear trains – Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box - Differential gear for an automobile.

TEXT BOOKS:

1. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.

REFERENCE BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4 thEdition, Oxford University Press, 2014.
2. Sadhu Sigh, "Theory of Machines", Third Edition, Pearson Education, 2012.
3. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
5. Rao. J.S. and Duggipati. R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., NewDelhi, 1992.

Handwritten signatures and marks:
Rattan
S.S. Rattan
Sadhu Sigh
Thomas Bevan
Robert L. Norton
Rao. J.S. and Duggipati. R.V.
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FLUID MECHANICS & HYDRAULIC MACHINES

B.Tech. II Year II Sem.

L	T	P	C
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Course Outcomes:

1. Understand fluid properties and fluid statics.
2. Identify type of fluid flow patterns, measuring fluid pressure and describe continuity equation.
3. Evaluate the flow losses in pipes and evaluating the forces on different vanes.
4. Analyze the performance of various turbines.
5. Appreciate the working principles of pumps and their applications.

UNIT – I:

Fluid statics: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures –

Measurement of pressure- Piezometer, U-tube and differential manometers.

UNIT – II:

Fluid kinematics: Stream line, path line and streak lines and stream tube, classification of flows- steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.

Fluid dynamics: Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend. Measurement of flow: Pitot tube, venturi meter, and orifice meter.

UNIT – III:

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

UNIT – IV:

Hydraulic Turbines: Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.

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Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities.

UNIT – V:

Centrifugal pumps: Classification, working, work done – barometric head-losses and efficiencies specific speed.

Reciprocating pumps: Working, Discharge, slip.

TEXT BOOKS:

1. Fluid Mechanics and Hydraulic Machines by Er. R. K. Bansal, Laxmi publication.

REFERENCE BOOKS:

1. Hydraulics, Fluid mechanics and Hydraulic Machinery - MODI and SETH, 21st Edition, standard Book House.
2. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K. Kataria & Sons, 2018
3. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International publishers
4. Hydraulic Machines by T.R. Banga & S.C. Sharma, 7th Edition, Khanna Publishers

Math

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IC ENGINES & GAS TURBINES

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

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

1. Understand the concepts of IC Engine systems and its classification.
2. Analyze the combustion phenomenon in SI and CI engines.
3. Evaluate the testing and performance parameters of IC engines.
4. Evaluate the working principles of compressors in industrial applications.
5. Computation of performance characteristics of gas turbines.

UNIT – I:

I.C. Engines: Classification - Working principles of Four & Two stroke engine, SI & CI engines, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles - Engine systems – Carburetor and Fuel Injection Systems for SI engines, Fuel injection systems for CI engines, Ignition, Cooling and Lubrication system, Fuel properties and Combustion Stoichiometry.

UNIT – II:

Combustion in SI engines: Normal Combustion and abnormal combustion in SI engines – Importance of flame speed and effect of engine variables – Abnormal combustion, pre-ignition and knocking in SI Engines – Fuel requirements and fuel rating, anti-knock additives – combustion chamber – requirements, types of SI engines.

Combustion in CI engines: Four stages of combustion in CI engines – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence in Diesel engine – open and divided combustion chambers and fuel injection– Diesel fuel requirements and fuel rating

UNIT – III:

Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart

Compressors: Classification of compressors – Fans, blowers and compressors – positive displacement and dynamic types – reciprocating and rotary types.

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Reciprocating Compressors: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work, minimum work condition for staged compression.

UNIT – IV:

Rotary Compressor (Positive displacement type): Roots Blower, vane sealed compressor, mechanical details and principle of working – efficiency considerations.

Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

UNIT – V:

Gas Turbines: Simple Gas Turbine Plant – Ideal Cycle – Closed Cycle and Open Cycle for Gas Turbines, Constant Pressure Cycle, Constant Volume Cycle, Efficiency – Work Ratio and Optimum Pressure Ratio for Simple Gas Turbine Cycle. Parameters of Performance, Actual Cycle.

TEXT BOOKS:

1. I.C. Engines, V. Ganesan, 4th Edition, Mc Graw Hill

REFERENCE BOOKS:

1. Thermal Engineering, Mahesh M Rathore, Tata Mc Graw Hill, 2010
2. Applied Thermodynamics for Engineering Technologists, Eastop & McConkey, Pearson
3. Fundamentals of Classical Thermodynamics, Vanwylen G.J., Sonntag R.E., Wiley Eastern
4. Internal Combustion Engines Fundamentals, John B. Heywood, McGraw Hill Ed.

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INSTRUMENTATION AND CONTROL SYSTEMS

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course Outcome: After completion of the course, the student will be able to:

1. Understand the basic terms related to measurements and errors.
2. Appraise the displacement and Temperature measuring instruments.
3. Evaluate the working of various physical variable Level and pressure measuring instruments.
4. Comprehend the measuring of stress-strain developed in engineering components.
5. Comprehend the concept of control system and Force, Torque and Power measuring instruments.

UNIT – I:

Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics– sources of errors, Classification and elimination of errors.

UNIT – II:

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Using Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers.

Measurement of Temperature: Various Principles of measurement-

Classification: Expansion Type: Bimetallic Strip- Liquid in glass Thermometer;

Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry:

Optical Pyrometer.

UNIT – III:

Measurement of Pressure: Different principles used- Classification: Manometers, Dead weight pressure gauge Tester (Piston gauge), Bourdon pressure gauges, Bellows, Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges, ionization pressure gauges, McLeod pressure gauge.

Measurement of Level: Direct methods – Indirect methods – Capacitive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators –Bubbler level indicators.

UNIT – IV:

Flow measurement: Rotameter, magnetic, Ultrasonic, Turbine flowmeter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

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Stress-Strain measurements: Various types of stress and strain measurements – Selection and installation of metallic strain gauges; electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending, compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes.

UNIT – V:

Measurement of Force, Torque and Power: Elastic force meters, load cells, Torsion meters, Dynamometers.

Elements of Control Systems: Introduction, Importance – Classification – Open and closed systems- Servomechanisms – Examples with block diagrams.

TEXT BOOKS:

1. Principles of Industrial Instrumentation & Control Systems/Chennakesava R alaavala, -Cengage Learning/1st Edition, 2009.

REFERENCE BOOKS:

1. Basic Principles – Measurements (Instrumentation) & Control Systems /S. Bhaskar/ Anuradha Publications
2. Measurement Systems: Applications & design, E. O. Doebelin, TMH, Tata Mcgraw Hill/6th Edition, 2017.
3. Instrumentation, Measurement & Analysis, B.C. Nakra & K.K. Choudhary, TMH, 4th Edition, 2016.
4. Experimental Methods for Engineers / Holman
5. Mechanical and Industrial Measurements / R. K. Jain/ Khanna Publishers.
6. Mechanical Measurements / Sirohi and Radhakrishna / New Age International, 3rd Edition, 2013.

The block contains several handwritten signatures in blue ink. In the top left is a signature that appears to be 'Mata'. Below it are 'Sudar' and 'Bha'. To the right of these is a symbol consisting of a vertical line with a horizontal crossbar and a small hook at the top. Further right is a signature that looks like 'K-2'. Below the 'Sudar' and 'Bha' signatures are 'Arun' and 'Surya'. To the right of 'Surya' is a large, stylized signature. At the bottom center is a signature that appears to be 'Nisha'.

FLUID MECHANICS & HYDRAULIC MACHINES LABORATORY

B.Tech. II Year II Sem.

L	T	P	C
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Course Outcomes:

1. Test for the performance of different turbines and pumps.
2. analyze a variety of practical fluid flow and measuring devices
3. Evaluate the test results of hydraulic machinery with the standard reference values.

List of Experiments:

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Kaplan Turbine.
4. Performance Test on Single Stage Centrifugal Pump.
5. Performance Test on Multi Stage Centrifugal Pump.
6. Performance Test on Reciprocating Pump.
7. Calibration of Venturimeter.
8. Calibration of Orifice meter.
9. Determination of friction factor for a given pipe line.
10. Determination of loss of head due to sudden contraction in a pipeline.
11. Verification of Bernoulli's Theorems.

REFERENCES:

1. Fluid Mechanics and Hydraulic Machines by Er. R. K. Bansal, Laxmi publication

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INSTRUMENTATION LABORATORY
(A224387)

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

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

1. Understanding the different devices for measuring mechanical parameters.
2. Calibrate the measuring devices and analyze the errors in measurement.
3. Evaluate the instruments in terms of accuracy and precision

List of Experiments:

1. Calibration of Pressure Gauges.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotameter for flow measurement.
10. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of McLeod gauge for low pressure.

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VIDYA JYOTHI INSTITUTE OF TECHNOLOGY
An Autonomous Institution
Aziznagar Gate, C.B. Post, Hyderabad - 500 075, Telangana.

Minutes of the Board of studies (Mech) meeting held on 23rd January 2024 at 10.00 AM in Board Room

The following members were present.

S.No	Name of the Member	Designation	Signature
1.	Dr. G. Sreeram Reddy	Chairman	
2.	Dr.M.Shailaja	JNTUH Nominee	
3.	Dr. K. Kishore	Member	
4.	Dr. K. Sudhakar Reddy	Member	
5.	Mr. Ayush Nadimpalli	Member	
6.	Ms. A. Swapnika	Member	
7.	Dr. B.V. Reddi	Member	
8.	Dr. V.V.Satyanarayana	Member	
9.	Dr. L. Madan Ananda Kumar	Member	
10.	Dr. B. Ravinder Reddy	Member	

PTO

Item No. 1: Approval of R22 B.Tech 3rd Year I Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech III Year I Semester viz.

1. Dynamics of Machinery
2. Metrology & Machine Tools
3. Steam Power & Jet Propulsion
4. CAD/CAM
5. Design of Machine Elements
6. Thermal Engineering Laboratory
7. Metrology & Machine Tools Laboratory
8. CAD/CAM Laboratory

b) The Chairperson also presented the syllabi of Open Electives to be offered during III year I semester viz.

Open Elective-I:

1. Basic Mechanical Engineering
2. Product Engineering

Item No. 2: Approval of R22 B.Tech 3rd Year II Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech III Year II Semester viz.

1. Machine Design
2. Heat Transfer
3. Heat Transfer Lab
4. Computer Aided Engineering Laboratory

b) The Chairperson also presented the syllabi of Professional Electives and Open Electives to be offered during III year II semester viz.

Professional Elective-I:

1. Finite Element Method
2. Additive Manufacturing
3. Composite Materials
4. Microprocessors in Automation

Open Elective-II:

1. Materials & Applications
2. Industrial Engineering



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- c) The Chairperson also presented the syllabi of mini project to be offered during III year II semester viz.

1. Industry Oriented Mini Project/Internship

Item No. 3: Approval of R22 B.Tech 4th Year I Semesters Syllabi

- a) The Chairperson presented the syllabi of the following subjects of B.Tech IV Year I Semester viz.

1. Industrial Management
2. Refrigeration & Air Conditioning

- b) The Chairperson also presented the syllabi of Professional Electives and Open Electives to be offered during IV year I semester viz.

Professional Elective II:

1. Artificial Intelligence in Mechanical Engineering
2. Industry 4.0
3. Industrial Robotics
4. Production Planning & Control

Professional Elective III:

1. Operations Research
2. Computational Fluid Dynamics
3. Total Quality Management
4. Solar Energy Technology

Professional Elective IV:

1. Re-Engineering
2. Non-Conventional Energy Sources
3. Automobile Engineering
4. Electric and Hybrid Vehicles

Open Elective III:

1. Basic Automobile Engineering
2. Maintenance and Safety Engineering

- c) The Chairperson also presented the syllabi of project to be offered during IV year I semester viz.

1. Project Stage-I

Item No. 4: Approval of R22 B.Tech 4th Year II Semesters Syllabi

- a) The Chairperson presented the syllabi of the following subjects of B.Tech IV Year II Semester viz.

1. Unconventional Machining Process
2. Plant Layout & Material Handling
3. Power Plant Engineering



b) The Chairperson also presented the syllabi of project to be offered during IV year II semester viz.

1. Project Stage-II including Seminar

Item No. 5: Approval of R22 B.Tech (Minor in Robotics) III Year I Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech III Year I Semester viz. for "Minor in Robotics" students.

1. Principles of Robotics
2. SCI Lab for Robotics Lab

Item No. 6: Approval of R22 B.Tech (Minor in Robotics) III Year II Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech III Year II Semester viz. for "Minor in Robotics" students.

1. Microcontrollers for Robotics

Item No. 7: Approval of R22 B.Tech (Minor in Robotics) IV Year I Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech IV Year I Semester viz. for "Minor in Robotics" students.

1. Advanced Robotics (or) SWAYAM course on Introduction to Robotics
2. Robotic Simulation Lab

Item No. 8: Approval of R22 B.Tech (Minor in Robotics) IV Year II Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech IV Year II Semester viz. for "Minor in Robotics" students.

1. Implementation of Robotic Systems
2. Mini Project

Item No. 9: Approval of R22 B.Tech (Honors) III Year I Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech III Year I Semester viz. for "Honors" students.

1. Industrial Robotics

Item No. 10: Approval of R22 B.Tech (Honors) III Year II Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech III Year II Semester viz. for "Honors" students.

1. Additive Manufacturing (or) SWAYAM Course "Fundamentals of Additive Manufacturing Technologies" equivalent to Additive Manufacturing
2. Robotic Simulation & 3D Printing Laboratory



Item No.11: Approval of R22 B.Tech (Honors) IV Year I Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech IV Year I Semester viz. for "Honors" students.

1. Advanced Finite Element Method
2. Technical Paper Writing

Item No. 12: Approval of R22 B.Tech (Honors) IV Year II Semesters Syllabi

a) The Chairperson presented the syllabi of the following subjects of B.Tech IV Year II Semester viz. for "Honors" students.

1. Advanced CAD
2. CAD/CAM /CAE Laboratory

Noted and Approved.

Signatures of the Members Present:

S.No	Name of the Member	Designation	Signature
1.	Dr. G. Sreeram Reddy	Chairman	
2.	Dr.M.Shailaja	JNTUH Nominee	
3.	Dr. K. Kishore	Member	
4.	Dr. K. Sudhakar Reddy	Member	
5.	Mr. Ayush Nadimpalli	Member	
6.	Ms. A. Swapnika	Member	
7.	Dr. B.V. Reddi	Member	
8.	Dr. V.V.Satyanarayana	Member	
9.	Dr. L. Madan Ananda Kumar	Member	
10.	Dr. B. Ravinder Reddy	Member	











VIDYA JYOTHI INSTITUTE OF TECHNOLOGY

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Department of Mechanical Engineering R22 COURSE STRUCTURE

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.		Dynamics of Machinery	3	0	0	3
2.		Metrology & Machine Tools	3	0	0	3
3.		Steam Power & Jet Propulsion	3	0	0	3
4.		CAD/CAM	2	0	0	2
5.		Design of Machine Elements	3	0	0	3
6.		Open Elective-I: a) Basic Mechanical Engineering b) Product Engineering	3	0	0	3
7.		Thermal Engineering Laboratory	0	0	2	1
8.		Metrology & Machine Tools Laboratory	0	0	2	1
9.		CAD/CAM Laboratory	0	0	2	1
10.		Environmental Science	3	0	0	0
Total Credits			20	0	8	20

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1.		Machine Design	3	0	0	3
2.		Heat Transfer	3	0	0	3
3.		Business Economics & Financial Analysis	3	0	0	3
4.		Professional Elective – I: a) Finite Element Method b) Additive Manufacturing c) Composite Materials d) Microprocessors in Automation	3	0	0	3
5.		Open Elective – II: a) Materials & Applications b) Industrial Engineering	3	0	0	3
6.		Heat Transfer Lab	0	0	2	1
7.		Computer Aided Engineering Laboratory	0	0	2	1
8.		Advanced English Communication Skills Laboratory	0	0	2	1
9.		Industry Oriented Mini Project/ Internship	0	0	4	2
10.		Gender Sensitization	3	0	0	0
Total Credits			18	0	10	20











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Department of Mechanical Engineering R22 COURSE STRUCTURE

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.		Industrial Management	2	0	0	2
2.		Refrigeration & Air Conditioning	3	0	0	3
3.		Professional Elective – II: a) Artificial Intelligence in Mechanical Engineering b) Industry 4.0 c) Industrial Robotics d) Production Planning & Control	3	0	0	3
4.		Professional Elective – III: a) Operations Research b) Computational Fluid Dynamics c) Total Quality Management d) Solar Energy Technology	3	0	0	3
5.		Professional Elective – IV: a) Re-Engineering b) Non-Conventional Energy Sources c) Automobile Engineering d) Electric and Hybrid Vehicles	3	0	0	3
6.		Open Elective – III: a) Basic Automobile Engineering b) Maintenance and Safety Engineering	3	0	0	3
7.		Project Stage - I	0	0	6	3
Total Credits			17	0	6	20

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.		Unconventional Machining Process	3	0	0	3
2.		Plant Layout & Material Handling	3	0	0	3
3.		Power Plant Engineering	3	0	0	3
4.		Project Stage – II including seminar	0	0	22	9+2
Total Credits			9	0	22	20



VIDYA JYOTHI INSTITUTE OF TECHNOLOGY

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Department of Mechanical Engineering

R22 COURSE STRUCTURE

B.TECH HONORS IN CAD/CAM

S. No.	Year/Sem	Course Title	L	T	P	Credits
1	III-I	Industrial Robotics	4	0	0	4
2	III-II	Additive Manufacturing (or) SWAYAM Course on Fundamentals of Additive Manufacturing Technologies	4	0	0	4
3		Robotic Simulation & 3D Printing Lab	0	0	3	1.5
4	IV-I	Advanced Finite Element Method	3	0	0	3
5		Technical Paper Writing	0	0	4	2
6	IV-II	Advanced CAD	4	0	0	4
7		CAD/CAM/CAE Lab	0	0	3	1.5
Total			15	0	10	20





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Department of Mechanical Engineering

R22 COURSE STRUCTURE

B.TECH MINOR IN ROBOTICS

S. No.	Year/Sem	Course Title	L	T	P	Credits
1	III-I	Principles of Robotics	3	0	0	3
2		SCI Lab for Robotics Lab	0	0	3	1.5
3	III-II	Microcontrollers for Robotics	3	0	0	3
4	IV-I	Advanced Robotics (or) SWAYAM course on Introduction to Robotics	4	0	0	4
5		Robotic Simulation Lab	0	0	3	1.5
6	IV-II	Implementation of Robotic Systems	3	0	0	3
7		Mini Project	0	0	4	2
Total			13	0	10	18

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DYNAMICS OF MACHINERY

B. Tech. III Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand gyroscopic effects of rotating bodies for aero planes, naval ships, automobiles, and two wheelers. Appreciate the working of brakes and dynamometers.
2. Compute frictional torque in clutches and understand the applications of Governors in mechanical systems.
3. Perform static and dynamic force analysis of planar mechanisms. Diagrammatically represent turning moment and design flywheels.
4. Understand how to balance rotating and reciprocating masses in different planes.
5. Perform calculations pertinent to several parameters of free and forced vibrations.

UNIT-I

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

Brakes and Dynamometers: Simple block brakes, internal expanding brake, band brake of vehicle, Dynamometers – absorption and transmission types.

UNIT-II

Clutches: Friction clutches Single Disc or plate clutch, Multiple Disc clutch, Cone clutch, Centrifugal clutch.

Governors: Watt, Porter and Proell governors, Sensitiveness, isochronisms and hunting.

UNIT-III

Static and Dynamic Force Analysis of Planar Mechanisms: Introduction Free Body Diagrams Conditions for equilibrium two, three and four force Members Inertia forces and D'Alembert's Principle planar rotation about a fixed center.

Fly Wheels: Fluctuation of energy fly wheels and their design.

UNIT-IV

Balancing: Balancing of rotating masses, single and different planes. Balancing of Reciprocating Masses, Primary and secondary balancing of reciprocating masses. Analytical and graphical methods unbalanced forces and couples Multi cylinder in line and radial engines, balancing of locomotive.

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UNIT-V

Vibration: Free Vibration of mass attached to vertical spring Forced damped vibration, Vibration isolation & Transmissibility Whirling of shafts, critical speeds, Torsional vibrations of two and three rotor systems.

Text Book:

1. Theory of Machines, S.S. Ratan, Mc Graw Hill.

Reference Books:

1. Theory of Machines, Shigley, Mc Graw Hill.
2. Theory of Machines, Thomas Bevan, CBS Publishers
3. Mechanism and Machine Theory, JS Rao and RV Dukkipati, Newage
4. Theory of Machines, R S Khurmi, S K Gupta, S Chand publications



METROLOGY & MACHINE TOOLS

B. Tech. III Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes

1. Understand the mechanics of metal cutting and working principles of lathe machines.
2. Understand the working, classification, specifications and kinematic schemes of shaping, planing, drilling and boring machines.
3. Practicing the operations of milling, grinding, lapping, honing and broaching machines.
4. Understand the concepts of limits, fits and interchangeability. Design of GO and NO GO gauges.
5. Measuring different parameters of surface roughness and the working of Coordinate Measuring Machine.

UNIT - I

Metal Cutting: Introduction, elements of cutting process orthogonal cutting, merchant circle, oblique cutting, Geometry of single point tools. ASA system. Chip formation and types of chips.

Engine Lathe: Principle of working, types of lathe, specifications. Taper turning Lathe attachments. Capstan and Turret lathe Single Spindle and Multi-Spindle automatic lathes tool layouts.

UNIT - II

Drilling and Boring Machines: Principles of working, specifications, types, operations performed; twist drill. Types of Boring machines and applications.

Shaping, Slotting and Planning Machines- Principles of working machining time calculations.

UNIT - III

Milling Machines: Principles of working Types of milling machines Geometry of milling cutters methods of indexing, machining time calculations.

Grinding: Theory of grinding classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, Honing, comparison and Constructional features.





UNIT – IV

Limits, Fits and Tolerances: Unilateral and bilateral tolerance system, hole and shaft basis system, Interchangeability and selective assembly. Limit gauges: Taylor's principle, Design of GO and NO GO gauges. Measurement of angles, Bevel protractor, Sine bar. Measurement of flat surfaces: optical flat, auto collimator.

UNIT – V

Surface Roughness Measurement: Roughness, Waviness, CLA Values. Methods of measurement of surface finish, Talysurf. Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines.

Coordinate Measuring Machines: Types and Applications of CMM.

Text Book:

1. Manufacturing Technology Vol.2, P.N. Rao, McGraw Hill

Reference Books:

1. Engineering Metrology, M. Mahajan, Danpat Rai Publishers
2. Production Technology, Hindustan Machine Tools, McGraw Hill
3. Principles of Machine Tools, Bhattacharya A and Sen.G.C. New Central Book Agency.
4. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, Wiley.

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STEAM POWER & JET PROPULSION

B. Tech. III Year I Semester - MECH

L	T	P	C
3	0	0	3

Note: Steam Table Book are Permitted in the Examinations.

Course Outcomes:

1. Understand the working of steam power plants and boilers.
2. Perform Thermodynamic analysis of nozzles and condensers.
3. Analyze impulse and reaction steam turbines and subsequently apply to real time scenarios.
4. Understand working of different types of compressors and gas turbines.
5. Appreciate different types of propulsive engines and rockets.

UNIT – I

Steam Power Plant: Rankine cycle - Schematic layout, Thermodynamic analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance Regeneration & reheating.

Boilers: Classification working principles with sketches including H.P. Boilers Mountings and Accessories Working principle. Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance

UNIT – II

Steam Nozzles: Function of nozzle Applications and Types- Flow through nozzles- Thermodynamic analysis-Velocity at nozzle exit-Ideal and actual expansion in nozzle- Condition for maximum discharge- Critical pressure ratio- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson Line

Steam Condensers: Requirements of steam condensing plant Classification of condensers Working principle of different types-Vacuum efficiency and Condenser efficiency Air leakage, sources and its affects, Air pump- Cooling water requirement

UNIT – III

Steam Turbines: Impulse Turbine Mechanical details Velocity diagram Effect of friction Power developed, Axial thrust, Blade or diagram efficiency Condition for maximum efficiency, De-Laval Turbine - its features, Methods to reduce rotor speed

Reaction Turbine: Mechanical details Principle of operation, Thermodynamic analysis of a stage, Degree of reaction Velocity diagram Parson's reaction turbine Condition for maximum efficiency.

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UNIT-IV

Reciprocating Compressors: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work, minimum work condition for staged compression

Gas Turbines: Simple gas turbine plant Ideal cycle, essential components Parameters of performance Actual cycle Regeneration, Intercooling and Reheating Closed and Semi-closed cycles.

UNIT – V

Jet Propulsion: Principle of Operation Classification of jet propulsive engines Working Principles with schematic diagrams and representation on T-S diagram Thrust, Thrust Power and Propulsion Efficiency Turbo jet engines Needs and Demands met by Turbo jet Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation Methods.

Rockets: Application Working Principle Classification Propellant Type Thrust, Propulsive Efficiency Specific Impulse Solid and Liquid propellant Rocket Engines.

Text Book:

1. Thermal Engineering, Rajput, Lakshmi Publications.

Reference Books:

1. Thermodynamics and Heat Engines, R. Yadav, Central Book Depot.
2. Thermal Engineering, Ballaney, Khanna Publications.
3. Gas Turbines, V.Ganesan, TMH.
4. Thermal Engineering, Mahesh M Rathore, Mc Graw Hill



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CAD/CAM

B. Tech. III Year I Semester - MECH

L	T	P	C
2	0	0	2

Course Outcomes:

1. Appreciate CAD/CAM principles and know the various input and output peripherals of computers. Understand concepts of computer graphics.
2. Develop mathematical models to represent curves, surfaces and solids.
3. Understand numerical control systems and develop CNC part programs. Appraise the rudiments of Group Technology.
4. Understand Computer Aided Quality Control and Computer Integrated Manufacturing Systems.
5. Applying FMS concepts for production of engineering components.

UNIT – I

Introduction: Computers in industrial manufacturing, Product cycle, CAD/CAM hardware basic structure, CPU, memory types, input devices, display devices, hard copy devices, storage devices.

Computer Graphics: Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 2D and 3D transformations, viewing transformation, mathematics of projections, windowing and clipping, hidden surface removal.

UNIT – II

Geometric Modeling: Requirements, Geometric models, Curve representation methods, Surface representation methods, modeling facilities desired.

CAD Standards- Graphical kernel system, standards for exchange images, open graphics library, data exchange standards- IGES, STEP, and CALS etc.

UNIT – III

Numerical Control: NC, NC modes, NC machine tools structure of CNC machine tools, features of machining center, turning center, CNC part programming: Fundamentals, manual part programming methods, computer aided part programming.

Group Technology: Part family, coding and classification, production flow analysis, advantages and limitations, computer aided processes planning, retrieval type and generative type.





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UNIT – IV

Computer Aided Quality Control: Terminology in quality control, computer applications, contact inspection methods, noncontact inspection methods Optical, Noncontact, and inspection methods non optical, Computer aided testing, integration of CAQC with CAD/CAM.

Computer Integrated Manufacturing Systems: Types of manufacturing systems, Machine tools and related equipment, computer control systems, human labour in the manufacturing systems, CIMS benefits.

UNIT – V

Flexible Manufacturing Systems: Introduction, Main Objectives, FMS Equipment, Tool Management system, System layouts, FMS control

Text Book:

1. CAD/CAM Principles and Applications, P.N. Rao, Mc Graw Hill.

Reference Books:

1. CAD/CAM: Computer- Aided Design and Manufacturing, Mikell P.Groover, Emory. W.Zimmers, Pearson Education India, 1984.
2. CAD/CAM: Theory and Practice, Ibrahim Zeid, R Sivasubramanian, Mc Graw-Hill.
3. Automation, Production Systems & Computer Integrated Manufacturing, P. Groover, Pearson Education, 2016
4. Computer Numerical Control Concepts and Programming, Warren S. Seames, Vengage Learning, 2007.



DESIGN OF MACHINE ELEMENTS

B. Tech. III Year I Semester - MECH

L	T	P	C
3	0	0	3

NOTE: Design Data books are not permitted in the Examinations.

Course Outcomes:

1. Understand the design procedure and selection of material for a specific application. Analyze the simple stresses and strains in components.
2. Appreciate variable stresses in mechanical components, fatigue analysis and fatigue theories of failure.
3. Design fastened joints like riveted and welded joints.
4. Design various joints like bolted joints, keys, cotter joints and knuckle joint.
5. Design shafts for strength and rigidity. Design rigid and flexible shaft couplings.

UNIT – I

Introduction: General considerations in the design of engineering components Materials and their properties selection manufacturing consideration in design.

Stresses in Machine Members: Simple stresses Complex stresses impact stresses stress strain relations static theories of failure factor of safety Design for strength and rigidity. The concept of stiffness in tension, bending, torsion and combined situations.

UNIT – II

Stresses Due to Fatigue Loading: Stress concentration Theoretical stress Concentration factor Fatigue stress concentration factor notch sensitivity Design for fluctuating stresses Endurance limit Estimation of Endurance strength Fatigue theories of failure Goodman and Soderberg.

UNIT – III

Riveted Joints: Modes of failure of riveted joints Strength equations efficiency of riveted joints eccentrically loaded riveted joints.

Welded Joints: Design of Fillet welds axial loads Circular fillet welds bending and torsion eccentrically loaded joints.

UNIT – IV

Bolted Joints: Design of bolts with pre-stresses Design of joints under eccentric loading bolt of uniform strength, Cylinder cover joints.

Axially Loaded Joints: Keys, cotters and Knuckle joints: Design of keys-stresses in keys Cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints, Knuckle joints.

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UNIT – V

Design of Shafts: Design of solid and hollow shafts for strength and rigidity Design of shafts for complex loads Shaft sizes BIS code Design of shaft for a gear and belt drives.

Design of Shaft Couplings: Rigid couplings Muff, split muff and flange couplings, Flexible couplings Pin Bush coupling.

Text Book:

1. Machine Design, V.Bhandari, TMH Publishers

Reference Books:

1. Machine Design, Pandya & Shah, Charotar Publishing House Pvt. Ltd
2. Machine Design, R.L.Norton, Mc Graw Hill
3. Design of Machine Elements, Kulkarni, Mc Graw Hill.
4. Shigley's Mechanical Engineering Design, Richard G. Budynas, J. Keith Nisbett, Mc Graw Hill.

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BASIC MECHANICAL ENGINEERING OPEN ELECTIVE-I

B. Tech. III Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand the basic concepts of mechanical engineering.
2. Apply principles of engineering mechanics in mechanism and machines
3. Develop manufacturing methods to produce engineering components.
4. Evaluate alternative designs for the engineering components
5. Select a suitable type of automation applicable for any industry.

UNIT-I

Thermal Engineering Basic Concepts: Zeroth Law of Thermodynamics First law of Thermodynamics- Second Law of Thermodynamics Boyles Law Charles Law Thermodynamic processes Otto cycle Diesel cycle- Four stroke petrol and diesel engines, Brake Power, Indicated Power, Mechanical efficiency, Air Refrigeration, Vapour Compression Refrigeration.

UNIT-II

Theory of Machines : Types of Gears and Geartrains Transmission of power by Belts, Ropes and Chain drives Cams and Followers. Free Vibration of mass attached to vertical spring Oscillation of pendulums Transverse loads.

UNIT-III

Production Technology : Metal Casting Sand Casting, Molten metal Pouring, Welding Arc Welding, Gas Welding, Brazing, Soldering. Metal Forming Forging, Drawing, Extrusion. Metal Cutting Lathe, Drilling, Milling operations.

UNIT-IV

Introduction To Design: Elasticity and plasticity, Types of stresses and strains, Hooke's law stress strain diagram for mild steel, Working stress Factor of Safety, Lateral Strain, Poisson's ratio and volumetric strain Temperature stresses.

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UNIT-V

Automation and Robotics : Introduction to Automation in Manufacturing, CIM, CAD, CAM, CNC, Robots in industry, Robot Anatomy, Robot Configurations, Advantages, Disadvantages and Applications of robots.

Text Books:

1. Fundamentals of Mechanical Engineering, Pravin Kumar, Pearson, second edition.

Reference Books:

1. Elements of Mechanical Engineering, V. M. Manglik, PHI
2. Theory of Machines, Rattan .S.S, TMH, 2009 Edition.
3. Elements of Mechanical Engineering, Mathur M.L. & F.S. Mehta & Tewari, Jain Brothers Publishers.
4. Elements of Mechanical Engineering, Mathur M.L. & F.S. Mehta & Tewari, Jain Brothers Publishers

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PRODUCT ENGINEERING OPEN ELECTIVE-I

B. Tech. III Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Illustrate creativity and study the techniques of innovation
2. Assess the evaluation techniques for screening ideas
3. Differentiate the IPR-Patents, Design patents, copy right and trade mark and their laws.
4. Describe the interaction between design, manufacture, quality and testing
5. Establish the machining time in various cutting operations; value engineering; GT and concepts of concurrent engineering.

UNIT – I: Product Design and Process Design functions. Selection of right product. Systematic procedure of product innovation. Factors contributing to successful technological innovation – need for creativity and innovation. Techniques of innovation like brain storming and Delphi techniques.

UNIT – II: Project selection and evaluation: Function of design – Design with Human Machine Interaction (HMI), Collection of ideas and purpose of project. Selection criteria – screening ideas for new products using evaluation techniques. Principles of ergonomics.

UNIT – III: New Product Development: Research and new product development. Patents, definitions, patent search, patent laws, international code for patents – Intellectual Property Rights (IPR).

UNIT – IV: New Product Planning: Interaction between the functions of design, manufacture, quality, testing, and marketing. Steps for introducing new products after evaluation.

UNIT – V: Process Planning: Process planning, process sheets, Selection of manufacturing process, estimation of machining time in various cutting operations – estimation of costs for manufacture. Value engineering in product design, group technology, concepts of concurrent engineering.

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Text Book:

1. Chitale AK & Gupta R.C, Product Design & Manufacturing, – Prentice Hall of India, 1997.

Reference Books:

1. Niebel BW & Draper AB, Production Design & Process Engg., Mc Graw Hill Kogakusha, 1974.
2. Harry Nystrom, Creativity and Innovation, Jhon Wiley & Sons, 1979.
3. Brain Twiss, Managing Technological Innovation, Pittman Publ. 1992.
4. Harry, B. Waton, New Product Planning, Prentice Hall Inc., 1992.



THERMAL ENGINEERING LABORATORY

B. Tech. III Year I Semester - MECH

L	T	P	C
0	0	2	1

Course Outcomes

CO1: Understand the assembly/disassembly and their working of IC engines for performance measurement.

CO2: Analyze the output responses of the IC engines by applying thermodynamic principles.

CO3: Evaluate performance parameters for consequent applications.

1. I.C. Engines Valve / Port Timing Diagrams.
2. I.C. Engines Performance test (4 – Stroke Diesel Engines)
3. Heat balance on single cylinder 4 stroke diesel engine
4. Evaluate of engine friction by conducting Morse test on 4 stroke Multi cylinder petrol engine.
5. Evaluate of engine friction by conducting motoring test on 4 stroke petrol engine.
6. Evaluation of Performance and Combustion Characteristics of Dual Fuel Automotive CRDI Engine
7. Determination of Economical speed test for fixed load on 4-stroke engine.
8. Disassembly / Assembly of engines.
9. Performance test on reciprocating air-compressor unit.
10. Study of boilers.

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METROLOGY & MACHINE TOOLS LABORATORY

B. Tech. III Year I Semester - MECH

L	T	P	C
0	0	2	1

Course Outcomes

CO1: Understand the kinematic structure of machine tools and their mode of working.

CO2: Perform the machining operations and the measurement of samples using instruments.

CO3: Evaluate the responses for their accuracy and precision.

SECTION – A

1. Measurement of bores by internal micrometers and dial bore indicators.
2. Use of gear teeth, vernier calipers and checking the chordal addendum and chordal height of spur gear.
3. Machine tool alignment test on the lathe.
4. Tool maker's microscope.
5. Angle and taper measurements by Bevel protractor & Sine bars.
6. Thread measurement by two wire / three wire method or Tool Makers' microscope.

SECTION – B

1. Step turning and Taper Turning on Lathe Machine.
2. Thread cutting and knurling on lathe machine.
3. Drilling and Tapping
4. Shaping and Planning
5. Slotting
6. Milling
7. Surface Grinding

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CAD/CAM LABORATORY

B. Tech. III Year I Semester - MECH

L	T	P	C
0	0	2	1

Course Outcomes:

1. Understand the usage of relevant software and the syntax of CNC part program.
2. Develop the 2D, 3D models and conduct the analysis.
3. Evaluate the veracity between manual part program and the automated part program.

I. PART MODELLING

- a) Generate a 3D Model using Solid Works (Extrude command) as per diagram
- b) Generate a 3D Model using Solid Works (Revolve, sweep command) as per diagram.
- c) Generate a Surface Model using Solid Works as per diagram.

II. ASSEMBLY MODELING

- a) Generate an Assembly Model of Stuffing Box .
- b) Generate an Assembly Model of Screw Jack .

III. MANUFACTURING

- a) Introduction to CNC Simulation software.
- b) Develop a part programme for CNC turning using simulating software as per the given diagram and manufacture on CNC Lathe.
- c) Develop a part programme for CNC milling using simulating software as per the given diagram and manufacture on CNC Mill.

Software Packages: SOLIDWORKS, CAM Software





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MACHINE DESIGN

B. Tech. III Year II Semester - MECH

L	T	P	C
3	0	0	3

NOTE: Design Data books are permitted in the Examinations

Course Outcomes

1. Understand different sliding contact and rolling contact bearings and perform design calculations
2. Analyze design considerations of IC engine parts like piston, connecting rod and cylinder
3. Appraise the design aspects of belt drives and springs
4. Design spur gear drives by calculating different parameters
5. Compute design parameters of helical gear drives

UNIT – I

Sliding Contact Bearings: Types of Journal bearings basic modes of Lubrication Bearing construction bearing design bearing materials Selection of lubricants.

Rolling Contact Bearings: Types of rolling contact bearings selection of bearing type selection of bearing life Design for cyclic loads and speeds Static and dynamic loading of ball & roller bearings.

UNIT – II

Design of IC Engine Parts: Design of Connecting Rod; Thrust in connecting rod stress due to whipping action on connecting rod ends Pistons; Forces acting on piston Construction, Design and proportions of piston, Cylinder, Cylinder liners.

UNIT – III

Design of Belt and Rope Drives: Transmission of power by Belt and Rope drives, Transmission efficiencies, Flat and VBelts

Helical Springs: Design of springs, Stress in springs, Deflection of Springs in series, parallel conditions, composite springs

UNIT – IV

Design of Spur Gear Drives: Spur gears Load concentration factor Dynamic load factor, Surface compressive strength Bending strength Design analysis of Spur gears check for plastic deformation, Check for dynamic and wear considerations.

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UNIT – V

Design of Helical Gear Drives: Helical gears Load concentration factor Dynamic load factor, Surface compressive strength Bending strength Design analysis of Helical gears check for plastic deformation, Check for dynamic and wear considerations.

Text Book:

1. Machine Design, V.Bhandari, TMH Publishers

Reference Books:

1. Machine Design, Pandya & Shah, Charotar Publishing House Pvt. Ltd.
2. Machine Design, R.L.Norton, McGraw Hill
3. Mechanical Engineering Design, Bahi and Goel, Standard Publications.
4. Shigley's Mechanical Engineering Design, Richard G. Budynas, J. Keith Nisbett, Mc Graw Hill.

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HEAT TRANSFER

B. Tech. III Year II Semester -MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand the basic modes of heat transfer, steady and unsteady periodic heat transfer.
2. Solve 1-D problems of steady state and transient conduction heat transfer.
3. Appreciate concepts of convective heat transfer process and evaluate heat transfer coefficient for free and forced convection over exterior and interior surfaces with proper boundary conditions.
4. Applying the boiling and condensation principles in the heat transfer equipment design.
5. Analyze the performance of heat exchangers by LMTD and NTU methods. Appreciate radiation heat transfer scenarios.

UNIT – I

Introduction: Modes and mechanisms of heat transfer Basic laws of heat transfer General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier's law of conduction General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. Simplification and forms of the field equation-steady, unsteady and periodic heat transfer- initial and boundary conditions.

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres overall heat transfer coefficient electrical analogy Critical radius of insulation.

UNIT – II

One Dimensional Steady State Conduction Heat Transfer: Variable thermal conductivity systems with heat sources or Heat generation, extended surface (Fins) Heat Transfer Long Fin, Fin with insulated tip and short Fin, Application to error measurement of temperature.

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance Significance of Biot and Fourier Numbers Chart solutions of transient conduction systems Concept of Functional body.

UNIT – III

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, medium of flow – Dimensional analysis as a tool for experimental investigation Buckingham Pi Theorem and method , application for developing semi empirical non dimensional correlation for convection heat

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transfer Significance of non-dimensional numbers Concepts of Continuity, Momentum and Energy equations.

Forced Convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer - Flat plates and cylinders.

Internal Flows: Concepts of hydrodynamic and thermal entry lengths - Division of internal flow based on this - Use of empirical relations for horizontal pipe flow and annulus flow.

UNIT - IV

Free Convection: Development of hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for vertical plates and pipes

Boiling and Condensation: Pool boiling - Regimes Calculations on Nucleate boiling, Critical Heat flux and Film boiling. Film wise and Drop wise condensation on vertical and horizontal cylinders using empirical correlations.

UNIT - V

Heat Exchangers: Classification of heat exchangers overall heat transfer Coefficient and fouling factor LMTD and NTU methods Concepts and Problems

Radiation Heat Transfer: Emission characteristics and laws of black-body radiation irradiation total and monochromatic quantities laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann heat exchange between two black body's concepts of shape factor Emissivity heat exchange between grey bodies radiation shields electrical analogy for radiation networks.

Text Book:

1. Heat and Mass Transfer, R.K.Rajput, S.Chand Publications

Reference Books:

1. Heat Transfer A Practical Approach Yunus Cengel, Boles, Mc GrawHill.
2. Heat Transfer ,P.K.Nag , TMH
3. Fundamentals of Engg. Heat and Mass Transfer, R.C.Sachdeva, New Age International.
4. Heat and Mass Transfer, D. S Kumar ,S.K.Kataria& Sons



FINITE ELEMENT METHOD (PROFESSIONAL ELECTIVE – I)

B. Tech. III Year II Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand the basics of FEM, stress-strain relations and gain knowledge of Weighted Residual Methods and Variational Methods.
2. Solve 1-D problems by applying the pertinent boundary conditions.
3. Analyze and formulate finite element equations for 1-D planar truss element and beam element.
4. Solve 2-D problems using CST element and integration using Numerical Integration method.
5. Analyze and solve 1-D and 2-D heat transfer problems using FEM. Formulate Finite element equations for a stepped bar and a beam using dynamic analysis.

UNIT – I

Introduction To FEM: Basic concepts, historical background, Steps in FEM, applications of FEM, comparison of FEM with other methods, Basic equations of elasticity, Stress Strain and strain displacement relations, Rayleigh Ritz method, Galarkin's method, Problems.

UNIT – II

One Dimensional Problems: Shape functions, Stiffness matrix for a axial bar element, Assembly of Global stiffness matrix, properties of stiffness matrix, Finite element analysis of stepped and tapered bars subjected to mechanical and thermal loads, Quadratic shape functions, Problems.

UNIT – III

Analysis of Trusses: Finite Element Analysis of Trusses, Stiffness matrix of truss element, load vector, Problems.

Analysis of Beams: Analysis of 2-noded beam element with 2-DOF at each node, Hermite shape functions, stiffness matrix, load vector, problems with point load and uniformly distributed load.

UNIT – IV

2-D Structural Problems: CST element, Stiffness matrix and load vector for CST element, Introduction to LST element, Problems.

Isoparametric element representation, Shape functions, Convergence requirements, two dimensional four-node isoparametric elements, Numerical integration, Problems.

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UNIT – V

Analysis of Heat Transfer Problems: 1-D Heat conduction with lateral and edge convection, fin and composite wall analysis, 2-D heat transfer analysis, Problems.

Dynamic Analysis: Dynamic equations, Lumped and consistent mass matrices, Eigen Values and Eigen Vectors, mode shapes, Problems on stepped bars and beams.

Text Book:

1. Introduction to Finite Elements in Engineering, Tirupathi K. Chandrupatla and Ashok D. Belagundu, Pearson .

Reference Books:

1. The Finite Element Methods in Engineering, S.S.Rao, Elsevier, Pergamon
2. Finite Element Methods, Alavala, TMH
3. An Introduction to Finite Element Methods, J.N. Reddy, Mc Grawhill
4. Concepts and Applications of Finite Element Analysis – Robert Cook – Wiley





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ADDITIVE MANUFACTURING (PROFESSIONAL ELECTIVE – I)

B. Tech. III Year II Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand the working principle and process parameters of AM processes
2. Understand data formats of additive manufacturing
3. Appreciate Liquid-Based and Solid-Based additive manufacturing systems.
4. Apply the rudiments of Powder Based additive manufacturing Systems
5. Evaluate the applications of additive manufacturing in the industry

UNIT – I

Introduction to Additive Manufacturing: Introduction to AM, Distinction between AM & CNC machining, Steps in AM, ASTM Classification of AM processes, Advantages of AM and Types of materials for AM.

UNIT – II

AM Data Formats: STL file format (Binary and ASCII), Tessellation, Anisotropy.

STL File Problems: Unit changing, Vertex-to-vertex rule, Leaking STL files and Degenerated facets.

STL file printing parameters: Top and Bottom layers, Infill types and Shell thickness.

UNIT – III

Vat Photopolymerization AM Processes: Stereolithography(SL), working principle, photopolymers, applications, Process Benefits and Drawbacks.

Material Jetting and Binder Jetting AM Processes.

Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), working principle, Materials, Process Modelling, and Applications.

UNIT – IV

Powder Bed Fusion AM Processes: Selective laser Sintering (SLS), working principle, Materials, SLS Metal and ceramic part creation,

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Electron Beam melting (EBM) process, Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

Directed Energy Deposition AM Processes: working principle and applications of Laser Engineered Net Shaping (LENS) and Direct Metal Deposition (DMD) processes.

UNIT -V

AM Applications: Application in Engineering, Aerospace Industry, Automotive Industry and Jewelry Industry. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices.

Text Book:

1. Additive Manufacturing Technologies - Ian Gibson, David Rosen, Brent Stucker and Mahyar Khorasani, Springer publications.

Reference Books:

1. Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou L.W. and Liou F.W, CRC Press, 2007.
2. Rapid Prototyping & Engineering Applications, Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.
3. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer , 2001
4. Rapid Prototyping: Principles and Applications - Chua C.K., Leong, World Scientific Publishing Co Pvt. Ltd.

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COMPOSITE MATERIALS (PROFESSIONAL ELECTIVE – I)

B. Tech. III Year II Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Knowledge of the crystal structures of a wide range of ceramic materials and glasses.
2. Able to explain how common fibers are produced and how the properties of the fibers are related to the internal structure.
3. Able to select matrices for composite materials in different applications.
4. Able to describe key processing methods for fabricating composites.
5. Evaluate the properties of composites.

UNIT - I

Introduction: Definition, Classification of Composite materials based on structure, based on matrix, Advantages of composites, Applications of composites, Functional requirements of reinforcement and matrix.

UNIT - II

Types of reinforcements and their properties: Fibers: Carbon, Boron, Glass, Aramid, Al_2O_3 , SiC, Nature and manufacture of glass, carbon and aramid fibres, Comparison of fibres. Role of interfaces: Wettability and Bonding, The interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial strength.

UNIT - III

Fabrication of Polymeric Matrix Composites, Structure and properties of Polymeric Matrix Composites, Interface in Polymeric Matrix Composites, Applications; Fabrication of Ceramic Matrix Composites, Properties of Ceramic Matrix Composites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites Applications of Ceramic Matrix Composites.

UNIT - IV

Fabrication of Metal Matrix Composites: 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; Discontinuously reinforced Metal Matrix Composites, Properties and Applications. Fabrication of Carbon fiber composites, properties, interface and applications.

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UNIT - V

Micromechanics of Composites: Density, Mechanical Properties: Prediction of Elastic constants, Micro mechanical approach, Halpin-Tsai equations, Transverse stresses; Thermal properties: Hydrothermal stresses and Mechanics of Load transfer from matrix to fiber.

TEXTS BOOKS:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.

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





MICROPROCESSOR IN AUTOMATION (PROFESSIONAL ELECTIVE – I)

B. Tech. III Year II Semester - MECH

L	T	P	C
3	0	0	3

COURSE OUTCOMES: At the end of this course, students would be able to:

1. Develop proficiency in understanding number systems, codes (BCD, Excess 3), and designing digital circuits using logic gates etc.
2. Attain a comprehensive understanding of 8085 microprocessor architecture, functional blocks, and timing/control signals.
3. Master 8085 assembly language programming and interfacing peripherals such as programmable interrupt controller (8255).
4. Acquire skills in interfacing analog-to-digital and digital-to-analog converters.
5. Understand the practical applications of microprocessors in diverse industries.

Unit I: Number Systems, codes: BCD, Excess 3, digital electronics: Logic Gates, combinational circuits design: Mux, Demux, Sequential logic circuits design: Flip-flops, Shift registers.

Unit II: Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals. Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.

Unit III: Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255).

Unit IV: Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253)

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Unit V: Applications of microprocessors in various industries: Automobiles, Medical, Pharmaceuticals, Textiles and Robotics.

TEXT BOOKS:

1. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
2. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.

REFERENCES:

1. Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd.
2. Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).
3. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall

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MATERIALS & APPLICATIONS (OPEN ELECTIVE-II)

B. Tech. III Year II Semester - MECH

L	T	P	C
3	0	0	3

COURSE OUTCOMES: At the end of the course, students will be able to

1. Classify the various materials that will be essential for the mechanical engineering applications and testing for their mechanical properties
2. Understanding the composition and properties of Ferrous and Non-Ferrous Alloys
3. Analyze the manufacturing methods of composite materials for their overall feasibility
4. Evaluate the properties of ceramics and polymers employed in engineering components
5. Understanding the features of nano materials and high entropy alloys for engineering applications

UNIT-I:

INTRODUCTION: Classification of engineering materials, mechanical properties of metals and their testing equipment/procedures, ASTM standards for testing of materials.

UNIT-II:

METALS AND METAL ALLOYS: Classification, composition, properties and usage. Ferrous alloys- steel, cast iron.

NON-FERROUS MATERIALS: Aluminum, Titanium, Copper and their alloys.

UNIT-III:

COMPOSITES: Classification of composites, Types of reinforcements, Properties of composites in comparison with standard materials

MANUFACTURING METHODS: Hand and spray lay - up, injection molding, resin injection, filament winding.

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UNIT – IV:

CERAMICS: Classification of ceramic materials, Crystal Structure, Properties of Ceramics and applications, Ceramic fabrication techniques.

POLYMERS: Classification, Thermoplastic and Thermosetting Polymers, Characteristics and Applications

UNIT – V:

MATERIALS IN NANO TECHNOLOGY: Applications, Metal nano particles (Iron and copper).

HIGH ENTROPY ALLOYS: High entropy alloys and oxides, Applications

TEXT BOOKS:

1. William. D. Callister, David G. Rethwisch, Materials Science and Engineering: An Introduction, John Wiley & Sons.
2. Donald R Askland and Pradeep P Phule, Essentials of Materials Science and Engineering, by Pradeep P. Fulay, Donald R. Askeland.

REFERENCE BOOKS:

1. George Murray, Charles V. White, Wolfgang Weise, Introduction to Engineering Materials, CRC Press.
2. Myer Kutz, Mechanical Engineers' Handbook, John Wiley & Sons.
3. M.A. Shah, K.A.Shah, Nano technology, the science of Small, WILEY, Second Edition.
4. E. Paul De Garmo, J.T. Black, R.A. Kohler, Materials and Processes in Manufacturing, John Wiley and Sons, Inc., NY, 11th Edition.

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INDUSTRIAL ENGINEERING (OPEN ELECTIVE-II)

B. Tech. III Year II Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understanding the concepts of industrial engineering in order to improve overall productivity of a given system
2. Analysing various layout factors with a view to reduce the cost per unit of production at different prospective layout
3. Designing the production plan with a high throughput at a given point of time
4. Reducing the inventory by evaluating various costs
5. Creating a quality system by following principles

UNIT – I

CONCEPTS OF INDUSTRIAL ENGINEERING: Productivity, Production, Productivity Improvement, Work Study: Method Study and Time Study, Flow Process Chart, multiple activity chart, Standard time computation, work sampling.

UNIT – II

PLANT LOCATION FACTORS: Quantitative and qualitative methods; types of production - Mass, batch, job. Types of plant layout - product, process and fixed position layouts, cellular layouts, Group Technology - Flexible Manufacturing systems.

UNIT – III

PRODUCTION PLANNING AND CONTROL: Production plan, loading, scheduling, Production planning by line of Controls, Materials Requirement Planning (MRP), Manufacturing Resource Planning (MRP II) Network scheduling - CPM and PERT.

UNIT – IV

INVENTORY CONTROL: ABC analysis, FSN analysis, VED Analysis, P System, Q System. Economic ordering quantity, Lead time, Buffer Stock, ASRS, Stores management.

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UNIT – V

QUALITY ENGINEERING: X, R, p, C charts, Acceptance Sampling, Kaizen, JIT, ISO-9000, Deming, Juran, Philip Crosby Concepts, Taguchi Quality loss function.

TEXT BOOKS:

1. Industrial Engineering and Management/ Banga and Sharma

REFERENCE BOOKS:

1. Industrial Engineering & Management/ SK Hajra Choudhury, Nirjhar Roy, AK Hajra Choudhury
2. PERT and CPM Principles and Applications /L S Srinath
3. Industrial Management/K.K.Ahuja
4. Production Systems - Planning Analysis And Control/ Riggs.





HEAT TRANSFER LAB

B. Tech. III Year II Semester - MECH

L	T	P	C
0	0	2	1

Course Outcomes:

1. Understand the structural features of heat transfer equipment and their mode of working.
2. Analyze the output responses by comparing with the heat transfer governing equations.
3. Evaluate the process parameters for designing the heat transfer devices.

LIST OF EXPERIMENTS

1. Composite Slab Apparatus Overall heat transfer co-efficient.
2. Heat Transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere.
4. Thermal Conductivity of given metal rod.
5. Heat Transfer in pin-fin.
6. Experiment on transient heat conduction.
7. Heat Transfer in forced convection apparatus.
8. Heat Transfer in natural convection.
9. Parallel and counter flow heat exchanger.
10. Emissive apparatus.
11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Study of Two Phase flow.

Reference Book:

1. Fundamentals of Heat Transfer & Mass Transfer, Incropera & Dewitt, John Wiley Pub.

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COMPUTER AIDED ENGINEERING LABORATORY

B. Tech. III Year II Semester - MECH

L	T	P	C
0	0	2	1

Course Outcomes:

1. Build FE models of mechanical components under various loading conditions.
2. Understand conductive and convective heat transfer analysis of 1-D & 2-D components.
3. Evaluate Modal analysis of beams, plates and shells for natural frequencies and mode shapes with different elements

List of Experiments

1. Introduction to modeling in ANSYS workbench.
2. Analysis of bar problems to determine nodal displacements and stresses.
3. Analysis of Plane Truss to determine member forces, member strains & stresses, joint deflections under static, thermal and combined loading.
4. Analysis of Spatial Truss to determine member forces, member strains & stresses, joint deflections under static, thermal and combined loading.
5. Analysis of Beam to determine the shear force and bending moment when subjected to a point load.
6. Analysis of Beam to determine the shear force and bending moment when subjected to a UDL.
7. Determine the nodal stresses for a given axi-symmetric problem.
8. Analyzing the temperature distribution in a 2-D problem subjected to conduction & convection.
9. Determining the Natural frequencies and different modes for a bar problem.
10. Analyzing the stresses for a given 3D component.

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INDUSTRY ORIENTED MINI PROJECT/INTERNSHIP

B. Tech. III Year II Semester - MECH

L	T	P	C
0	0	4	2

Course Outcomes:

1. Apply the engineering principles in the execution of a sub system under mechanical engineering domain.
2. Predict and solve the related issues of the sub system.
3. Evaluate the effectiveness of the sub systems the light of technical, ethical and other standards.

The students in a group of 4 to 5 works on an industry oriented topic approved by the head of the department and prepare a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

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INDUSTRIAL ROBOTICS (PROFESSIONAL ELECTIVE – II)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

After completion of the course, student will be able to:

1. Understand the basic concepts of robotics and know the components of industrial robots.
2. Derive forward and inverse kinematic models for robots.
3. Decide upon the selection of actuators and sensors for robots.
4. Appreciate different programming techniques and languages for robots.
5. Comprehend industrial applications and work cell design of robots.

UNIT – I

Introduction: Automation and Robotics, Overview of Robotics, Classification of robots by coordinate system and control systems, Components of industrial robots, Advantages, disadvantages of and applications of robots.

End Effectors: Classification of end effectors, Types and working principles of grippers, General considerations of gripper selection and design, Different tools used as end effectors.

UNIT – II

Motion Analysis: Basic translation and rotation matrices, Transformations, Composite transformations, Homogeneous transformation, Problems.

Manipulator Kinematics: Joint coordinates and world coordinates, forward and inverse kinematics of position and orientation, Problems.

UNIT – III

Robot Actuators: Introduction, Working principles, applications, advantages and limitations of Pneumatic, Hydraulic and Electric Actuators.

Robot Sensors: Classification of sensors, working principles of different types of sensors like position, velocity, tactile, proximity sensors etc.





UNIT – IV

Robot Programming: Methods of Robot Programming, Leadthrough Programming Methods, Motion Interpolation, Wait, Signal, and Delay Commands, Branching, Capabilities and Limitations of Leadthrough Methods.

Robot Languages: The Textual Robot Languages, Generations of Robot Programming Languages, Robot Language Structure, Robot Language Elements and Functions.

UNIT – V

Industrial Applications of Robots: Robot Applications in Manufacturing: Material handling, Processing, Assembly & Inspection.

Robot Cell Design: Robot workcells, robot-centered cell, in-line robot cell & mobile robot cell, multiple robots and machine interference, considerations in workcell design.

Text Book:

1. Industrial Robotics (Technology, Programming and Applications), Mikell P. Groover, Tata McGraw Hill Education Private Limited.

Reference Books:

1. Introduction to Robotics: Analysis, Control and Applications, Saeed Benjamin Niku, John Wiley & Sons.
2. Robotics and Control, R.K. Mittal & I.J. Nagrath, Tata McGraw Hill Publishing Company Limited.
3. Introduction to Robotics: Mechanics and Control, John J. Craig, Pearson Education International.
4. Robotics: Control, Sensing, Vision and Intelligence, K.S.Fu, R.C.Gonzalez & C.S.G.Lee, McGraw Hill Education.

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PRODUCTION PLANNING AND CONTROL (PROFESSIONAL ELECTIVE – II)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand production systems and their characteristics.
2. Evaluate MRP and JIT systems against traditional inventory control systems.
3. Understand basics of variability and its role in the performance of a production system.
4. Analyze aggregate planning strategies. Apply scheduling techniques to production systems.
5. Understand theory of constraints for effective management of production systems.

UNIT – I

Introduction: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.

Forecasting – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

UNIT – II

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems – continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only.

Aggregate planning –

Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

UNIT – III

Line Balancing: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.

Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

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UNIT – IV

Scheduling – Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling – job shop scheduling, line of balance (LOB) – objectives – steps involved.

UNIT – V

Dispatching: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

Follow up: definition – types of follow up – expediting – definition – expediting procedures-Applications of computers in planning and control.

TEXT BOOKS:

1. Operations management – Heizer- Pearson.

REFERENCE BOOKS:

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications
3. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

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INDUSTRIAL MANAGEMENT

B. Tech. IV Year I Semester - MECH

L	T	P	C
2	0	0	2

Course outcomes:

1. Understand the principles of management.
2. Able to design the organization structure.
3. Apply the techniques for plant location, design plant layout and value analysis.
4. Able to carry out work study and allied techniques.
5. Able to do job evaluation and human resource management effectively.

UNIT - I

Introduction to Management: Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Leadership Styles

UNIT - II

Designing Organizational Structures: Departmentalization and Decentralization, Types of Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT - III

Operations Management: Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Value analysis-Definition-types of values- Objectives

UNIT - IV:

Work Study: Introduction — definition — objectives — steps in work study — Method study — definition, objectives — steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations — work sampling.

Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart, – Attributes- Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance

Sampling- Single sampling- Double sampling plans-OC curves.

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UNIT - V

Job Evaluation: Methods of job evaluation — simple routing objective systems — classification method factor comparison method, point method, benefits of job evaluation and limitations.

Human Resource management: Recruitment, selection, training, performance appraisal, wages and incentives- time wage system, Taylor's differential piece rate system, bonus.

TEXT BOOKS

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.

REFERENCE BOOKS

1. Motion and Time Study by Ralph M Barnes/ John Willey & Sons Work Study by ILO.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/Khanna Publishers.
3. Production & Operation Management /Paner Selvam/PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.

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REFRIGERATION AND AIR CONDITIONING

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand the basic concepts of refrigeration and thermodynamically analyze air refrigeration systems.
2. Appreciate the working principle and thermodynamically analyze vapor compression refrigeration system.
3. Understand the working principles of vapor absorption and steam jet refrigeration systems.
4. Estimate the air conditioning load for comfort and industrial applications by applying the principles of psychrometry and design conditions.
5. Appraise Air Conditioning Systems and calculate the Cooling Load.

UNIT – I

Introduction to Refrigeration: Necessity and applications Unit of refrigeration and C.O.P. Mechanical Refrigeration, Ideal cycle of refrigeration.

Air Refrigeration: Bell Coleman cycle - Brayton Cycle - Open and Dense air refrigeration cycle Air craft cooling systems.

UNIT – II

Vapour Compression Refrigeration: Introduction working of simple VCR cycle - Representation of cycle on T-S and p-h charts Effect of sub cooling and super heating Actual VCR cycle Problems.

System Components: Compressors General classification working principles **Condensers** classification Working Principles, **Evaporators** classification Working Principles, **Expansion Devices** -Types Working Principles.

Refrigerants: Classification - Desirable properties commonly used refrigerants - Nomenclature.

UNIT III:

Vapor Absorption System: Introduction Description and working of NH_3 -Water system, Calculation of Maximum COP Water - Li-Br absorption system Triple Fluid absorption system.

Steam Jet Refrigeration System: Introduction Working Advantages and Disadvantages.

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UNIT IV:

Psychometric: Introduction Psychometric terms Psychometric processes.

Inside and Outside Design Conditions: Introduction Selection of inside design conditions Selection of outside design conditions.

UNIT – V:

Psychrometry of Air Conditioning Systems: Introduction- Summer Air conditioning system Winter Air conditioning system- All year air conditioning system.

Unitary refrigerant based systems.

Cooling Load Calculations: Introduction- Estimation of required cooling capacity.

Text Book:

1. A Course in Refrigeration and Air conditioning, SC Arora & Domkundwar, Dhanpatrai

Reference Books:

1. Principles of Refrigeration, Dossat, Pearson Education.
2. Refrigeration and Air Conditioning, CP Arora, TMH.
3. Refrigeration and Air Conditioning , RS Khurmi and JK Gupta, S.CHAND Publication
4. Refrigeration and Air Conditioning, Manohar Prasad, New Age.

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ARTIFICIAL INTELLIGENCE IN MECHANICAL ENGINEERING (PROFESSIONAL ELECTIVE – II)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

COURSE OUTCOMES: At the end of this course, students would be able to:

1. Understand the basics and the purpose of Artificial Intelligence
2. Illustrate the different applications of Machine learning
3. Apply the concept of AI in Robotics field
4. Evaluate the different applications of deep learning methods
5. Apply the concept of Artificial Intelligence in Mechanical and Manufacturing Industries

Unit-I: Introduction to Artificial Intelligence: Introduction to AI, Problem formulation, Problem Definition, Production systems, Control strategies, Search strategies, Problem characteristics, Production system characteristics, Specialized production systems, Problem solving methods, Problem graphs, Matching, Indexing and Heuristic functions, Hill Climbing, Depth first and Breath first, Constraints satisfaction — Related algorithms, Measure of performance and analysis of search algorithms.

Unit-II: Machine Learning and its Applications: Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation. Linear regression, Decision trees, over fitting. Instance based learning, Feature reduction, Collaborative filtering based recommendation. Probability and Bayes learning, Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM. Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning- case studies

Unit-III: Artificial Intelligence in Robotics: Reinforcement Learning- planning and search, localization, tracking, mapping and control- A* search algorithms- path smoothing algorithms - SLAM algorithm- Precision agriculture- Assistance robots-Robot Performance optimization-Case studies.

Unit-IV: Deep Learning and its Applications: Biological Motivation- Activation function-Cost function- Collaborative filtering-Vectorization-Back

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Propagation Algorithm with applications -Feed-Forward Neural Network
Algorithm-Recurrent Neural Network Algorithm with applications -
Convolution Neural Network with applications

Unit-V: Application of Artificial Intelligence in Mechanical Manufacturing Industries: Fault diagnosis- Quality inspection- Improving the safety of working places- Material modeling and smart materials-Automobile engineering- building self-driving cars and autonomous vehicles, Auto parking- Machine learning in Machine Tools and Manufacturing Industries.

TEXT BOOKS:

1. Mangey Ram, J. Paulo Davim, Soft Computing Techniques and Applications in Mechanical Engineering, IGI Global, USA, DOI: 10.4018/978-1-5225-30350,2022.ISBN13: 9781522530350

REFERENCES:

1. Kaushik Kumar, Divya Zindani, Paulo Davim, Artificial Intelligence in Mechanical and Industrial Engineering , ISBN 9781003011248, CRC Press, 2021.
2. Haykin Simon., Neural networks a comprehensive foundation, Pearson Education, 2nd Edition, ISBN-13: 978-0138958633, 1997.
3. E. Alpaydin, Introduction to Machine Learning, Prentice Hall of India, 2006.
4. Gebrail Bekda,Sinan Melih Nigdeli,Melda Yücel, "Artificial Intelligence and Machine Learning Applications in Civil, Mechanical, and Industrial Engineering (Advances in Computational Intelligence and Robotics)", 2019.

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INDUSTRY 4.0 (PROFESSIONAL ELECTIVE – II)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Explain Smart Business Perspective, Cyber security, Impacts of Industry 4.0.
2. Understand the basics of the Industrial Internet of Things.
3. Understand various key technologies.
4. Implement various sensors and actuators.
5. Understand different industrial transmission technologies and IIOT applications in real life

UNIT – I:

Industry 4.0 Basics: Industrial revolution: Phases, Evolution of Industry 4.0, Environmental impacts of industrial revolution, Applications, Design requirements, Drivers of Industry 4.0, Sustainability Assessment of industries, Smart Business Perspective, Cyber security, Impacts of Industry 4.0.

UNIT – II:

Industrial Internet of Things- Basics: IIoT and Industry 4.0, IIC, Industrial Internet Systems, Design of industrial internet systems, Impact of industrial internet, Benefits of industrial internet, Industrial sensing, Industrial Processes, Features of IIoT for industrial processes, Industrial plant-The future architecture, Digital Enterprise

Business Models and Reference Architecture of IIoT: Definition of a business model, Business models of IIoT, Industrial Internet Reference Architecture

UNIT –III:

Key Technologies: Off-site Technologies, Cloud Computing, Fog Computing

Key Technologies: On-site Technologies, Augmented Reality, Virtual Reality, Smart factories, Lean manufacturing system, Big Data and Advanced Analytics

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UNIT –IV:

Sensors: Various sensor types and their underlying working principles, Characteristics of Sensors – Resolution, calibration, accuracy and others, Sensor Categories – Thermal, Mechanical, Electrical, Optical and Acoustic sensors.

Actuators: Thermal, Hydraulic, Pneumatic, Electro mechanical Actuator

UNIT – V:

Industrial Data Transmission and Acquisition: Architecture of various data transmission technologies like Foundation Fieldbus, Profibus, Highway Addressable Remote Transducer (HART), Interbus, Bitbus, Digital STROM, Controller Area Network, and other recent and upcoming Technologies. Distributed Control System, SCADA and PLC System.

IOT Applications: IoT Applications on Industrial automation, Factories and Assembly line, Plant Security and Safety, Transportation, Agriculture, Healthcare, Home Automation, Oil, Chemical and Pharmaceutical Industry and others.

TEXT BOOK:

1. Introduction to Industrial Internet of Things and Industry 4.0 by Sudip Misra, Chandana Roy, Anandarup Mukherjee, CRC Press

REFERENCES:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
2. Vijay Madiseti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", University Press,
3. Dr. SRN Reddy, RachitThukral and Manasi Mishra, "Introduction to Internet of Things: Apractical Approach", ETI Labs
4. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media





OPERATIONS RESEARCH (PROFESSIONAL ELECTIVE – III)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Model the real life situations with mathematical models. Understand the concept of linear programming.
2. Solve transportation and assignment problems.
3. Understand the various waiting lines and replacement concepts.
4. Identify and apply game theory and inventory models.
5. Apply Sequencing shop floor problems and network scheduling models.

UNIT – I

Development Definition, historic developments of operation research, Characteristics and Phases Types of models Operations Research models applications.

Allocation: Linear Programming Problem Formulation Graphical solution Simplex method Artificial variables techniques: Two phase method, Big-M method; Duality Principle.

UNIT – II

Transportation Problem: Formulation Optimal solution, unbalanced transportation problem Degeneracy.

Assignment Problem: Formulation Optimal solution Variants of Assignment Problem; Traveling Salesman problem.

UNIT – III

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.

Waiting Lines: Introduction Terminology-Single Channel Poisson arrivals and Exponential Service times with infinite population and finite population models.

UNIT – IV

Theory of Games: Introduction Terminology Solution of games with saddle points and without saddle points- 2×2 games $m \times 2$ & $2 \times n$ games graphical method $m \times n$ games dominance principle.

Inventory: Introduction Single item, Deterministic models Types Purchase inventory models with one price break and multiple price breaks stochastic

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models demand discrete variable or continuous variable Single Period model with no setup cost.

UNIT – V

Sequencing: Introduction Flow Shop sequencing n jobs through two machines n jobs through three machines two jobs through ' m ' machines

Network Scheduling: Critical path method, Programme evaluation and review technique, crashing of networks, resource leveling.

Text Book:

1. Operations Research, S.D.Sharma, Kedarnath

Reference Books:

1. Operations Research, A.M. Natarajan, P. Balasubramaniam, A. Tamilarasi, Pearson.
2. Operations Research, Wagner, PHI Publications
3. Operations Research: Methods and Problems, Maurice Saseini, ArhurYaspan and Lawrence Friedman, Literary Licensing Publishers
4. Operations Research, ACS Kumar, Yesdee Publications

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COMPUTATIONAL FLUID DYNAMICS (PROFESSIONAL ELECTIVE – III)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand different types of Partial Differential Equations and to know and understand appropriate numerical techniques.
2. Solve the simple heat transfer and fluid flow problems using different numerical techniques, viz., FDM.
3. Understand and to appreciate the need for validation of numerical solution.
4. Apply finite difference solution to unsteady inviscid flow to long cylinder and sphere
5. Evaluation of fluid flow problems employing finite difference method

UNIT - I:

Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., – Main working principle – CFD as a research and design tool – Applications in various branches of Engineering Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding the physical and numerical aspects of the PDE – One way and Two Way variables – Well posed problems – Initial and Boundary Conditions Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition – Pivoting – Treatment of Banded Matrices – Thomas Algorithm Iterative Method: Gauss Seidel and Jordan Methods - Stability Criterion

UNIT - II:

Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams

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etc., - Solutions - Treatment of Curvilinear coordinates - Singularities - Finite Difference Discretization - Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates

UNIT - III:

FDM: Solution of physical problems with Parabolic type of Governing Equations - Initial Condition - Explicit, implicit and semi implicit methods - Types of errors - Stability and Consistency - Von Neumann Stability criterion - Solution of simple physical problems in 1D and 2D - Transient Heat conduction problems - ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations - Discretization using Explicit method - Stability criterion - Courant Number - CFL Condition - Its significance - Treatment of simple problems

UNIT - IV:

Finite Difference Solution of Unsteady Inviscid Flows: Lax - Wendroff Technique - Disadvantages - Maccormack's Technique Fluid Flow Equations - Finite Difference Solutions of 2D Viscous Incompressible flow problems - Vorticity and Stream Function Formulation - Finite Difference treatment of Lid Driven Cavity Problem - Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere - Obtaining Elliptic Equations

UNIT - V:

Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation - Discretization using FTCS method with respect to Upwind Scheme and Transport Property - Upwind Scheme and Artificial Viscosity Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid - Marker and Cell (MAC) Formulation - Numerical Stability Considerations - Pressure correction method - SIMPLE Algorithm

TEXT BOOKS:

1. Computational Fluid Dynamics: The basics with applications/ John D Anderson/McGraw Hill Publications

REFERENCE BOOKS:

1. Computational Fluid Flow and Heat Transfer / K Muralidharan and T Sudarajan/ Narosa Publishers.
2. Computational Methods for Fluid Dynamics / Firziger & Peric/ Springer
3. Numerical Heat Transfer and Fluid Flow/ S.V. Patankar/ Mc Graw Hill





TOTAL QUALITY MANAGEMENT (PROFESSIONAL ELECTIVE – III)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understanding the concepts of TQM
2. Setting bench marks for quality levels
3. Implementing TQM employing various tools
4. Evaluating the cost of quality of the products and processes
5. Design for achieving quality at ISO standards

UNIT-I Introduction, The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT-II Customer Focus and Satisfaction: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

UNIT-III Organizing for TQM: The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, Ishikawa diagram, paneto diagram, Kepner & Tregoe Methodology.

UNIT-IV The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

UNIT-V ISO 9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO 9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

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TEXT BOOKS:

1. Total Quality Management / Joel E. Ross/Taylor and Francis Limited

REFERENCE BOOKS:

1. Beyond TQM / Robert L. Flood.
2. Total Quality Management/P. N. Mukherjee/PHI
3. Statistical Quality Control / E. L. Grant.
4. Total Quality Management: A Practical Approach/H. Lal.



SOLAR ENERGY TECHNOLOGY (PROFESSIONAL ELECTIVE – III)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

1. Gain expertise in analyzing solar angles, employing Sun path diagrams, and evaluating the thermal performance of various solar collectors.
2. Acquire a deep understanding of the operation of solar heating/cooling systems, thermal energy storage.
3. Develop proficiency in semiconductor physics, comprehend solar cell properties, and analyze efficiency limits.
4. Factors such as shadow analysis, reliability, autonomy, and economic aspects of solar photovoltaic systems.
5. Attain expertise in passive heating and cooling concepts and understanding bioclimatic classifications

UNIT- I Solar Radiation and Collectors: Solar angles – Sun path diagrams – Radiation - extraterrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators -concentrators with point focus - Heliostats – performance of the collectors.

UNIT – II Solar Thermal Technologies: Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond –Solar drying

UNIT - III Solar PV Fundamentals: Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions – metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermophotovoltaic's.



UNIT- IV SPV System Design and Applications: Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design -storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT - V SOLAR PASSIVE ARCHITECTURE: Thermal comfort - bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling - Radiative cooling - application of wind, water and earth for cooling; shading - paints and cavity walls for cooling - roof radiation traps - earth air-tunnel. – energy efficient landscape design - thermal comfort.

TEXT BOOKS:

1. Goswami, D.Y., Kreider, J. F. and Francis., Principles of Solar Engineering, Taylor and Francis, 2000

REFERENCES:

1. Chetan Singh Solanki, Solar Photovoltaics – Fundamentals, Technologies and Applications, PHI Learning Private limited, 2011
2. Sukhatme S P, J K Nayak, Solar Energy – Principle of Thermal Storage and collection, McGraw Hill, 2008.
3. Solar Energy International, Photovoltaic – Design and Installation Manual – New Society Publishers, 2006
5. Roger Messenger and Jerry Vnetre, Photovoltaic Systems Engineering, CRC Press, 2010.



RE- ENGINEERING (PROFESSIONAL ELECTIVE – IV)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

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

1. Familiarize with the process of reverse engineering and its applications.
2. Understand the methodologies and techniques for Reverse Engineering.
3. Learn various data collection techniques and the data processing chain.
4. Select a proper system to generate geometric representations of physical objects.
5. Integrate Reverse Engineering and Rapid Prototyping.

UNIT – I Introduction to Reverse Engineering: Reverse Engineering –The Generic Process Reverse Engineering in Automotive, Aerospace, Medical sectors: Legal Aspects of Reverse Engineering: Copyright Law, Reverse Engineering, Recent Case Law, Barriers to Adopting Reverse Engineering. A discussion on a few benchmark case studies

UNIT –II Methodologies and Techniques for Reverse Engineering: The Potential for Automation with 3-D Laser Scanners, What Is Not Reverse Engineering, What is Computer-aided (Forward) Engineering, What Is Computer-aided Reverse Engineering, Computer Vision and Reverse Engineering, Structured light Range Imaging, Scanner Pipeline

UNIT – III Reverse Engineering–Hardware and Software: Contact Methods Noncontact Methods, Destructive Method, Reverse Engineering Software Classification, Fundamental Reverse Engineering Operations, Reverse Engineering Phases

UNIT - IV Selecting a Reverse Engineering System: The Selection Process, Some Additional Complexities, Point Capture Devices, Triangulation Approaches, “Time-of-flight” or Ranging Systems, Structured-light and Stereoscopic Imaging Systems, issues with Light-based Approaches, Tracking Systems, Internal Measurement Systems, X-ray Tomography, Destructive



Systems, Some Comments on Accuracy, Positioning the Probe, Post processing the Captured Data, Handling Data Points, Curve and Surface Creation, Inspection Applications, Manufacturing Approaches.

UNIT – V: Integration between Reverse Engineering and Rapid Prototyping: Modeling Cloud Data in Reverse Engineering, Data Processing for Rapid Prototyping, Integration of RE and RP for Layer-based Model Generation, Adaptive Slicing Approach for Cloud Data Modeling, Planar Polygon Curve Construction for a Layer, Determination of Adaptive Layer Thickness.

TEXT BOOK:

1. Reverse Engineering: An Industrial Perspective by Vinesh Raja and Kiran J. Fernandes, Springer-Verlag London Limited 2008

REFERENCE BOOKS:

1. K. Otto and K. Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001.
2. Anupam Saxena, Birendra Sahay, Computer Aided Engineering Design, Springer, 2005.
3. Ali K. Kamrani and Emad Abouel Nasr, Engineering Design and Rapid Prototyping, Springer, 2010.

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NON-CONVENTIONAL ENERGY SOURCES (PROFESSIONAL ELECTIVE – IV)

B. Tech. IV Year I Semester - MECH

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Course Outcomes:

1. Understanding Non-conventional energy sources
2. Knowledge of working principle of various energy systems
3. Capability to carry out basic design of Non-conventional energy systems.
4. Design the biogas systems and plants by understanding the properties
5. Build the ocean energy based power plants to harness green energy

UNIT-I Global and National Energy Scenario: Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO₂ reduction potential of renewable energy- concept of Hybrid systems.

UNIT-II Solar Energy: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

UNIT-III Wind Energy: Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

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UNIT-IV Biogas: Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

UNIT-V Ocean Energy: Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy:** Geothermal power plants, various types, hot springs and steam ejection.

TEXT BOOKS:

1. Renewable Energy Sources / Twidell, J.W. and Weir, A./ EFN Spon Ltd., 1986.

REFERENCE BOOKS:

1. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
2. Non-Conventional Energy Sources / G.D Rai/ Khanna Publishers
3. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

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AUTOMOBILE ENGINEERING (PROFESSIONAL ELECTIVE – IV)

B. Tech. IV Year I Semester - MECH

L	T	P	C
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Course Outcomes:

1. Understand the components of automobile engines and appreciate the working of lubrication and cooling systems. Know about the fuel systems in SI engine and CI engines.
2. Appreciate the functions and importance of ignition and electrical systems.
3. Elucidate the working principles, types and importance of transmission and suspension systems.
4. Appreciate the working principles, types and importance of braking and steering systems.
5. Understand the environmental implications of automobile emissions and application of various alternative fuels.

UNIT – I

Introduction about Evolution of Modern Automobiles- Components of four wheeler automobile rear wheel drive, front wheel drive, 4 wheel drivetypes of automobile engines.

Engine Lubrication System: Splash and pressure lubrication systems.

Cooling System: Cooling requirements, Air cooling, liquid cooling, Thermo, Water and forced lubrication system Radiators- Types- Cooling fans- Water pump Thermostat Evaporating cooling- Pressure cooling.

S.I. Engines: Fuel supply systems, Mechanical and electrical fuel pump filters carburetor types air filters petrol injection. M.P.F.I system, GDI system

C.I. Engines: Requirements of diesel injection systems, types of injection systems, Common Rail Diesel injection- fuel pump, nozzle, spray formation, injection timing.

UNIT--II

Ignition System: Function of an ignition system, battery ignition system, auto transformer, Magneto coil ignition system, electronic ignition system, spark advance and retard mechanism.

Electrical System: Charging circuit, generator, current voltage regulator starting system, bendix drive mechanism solenoid switch, lighting system, Horn, Wiper, fuel gauge oil pressure gauge, engine temperature indicator.

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UNIT – III

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, synchromesh gear boxes, epicyclic gear box, over drive, torque converter. Propeller shaft Hotch- Kiss drive, Torque tube drive, universal joint, differential, gear axles types wheels and tyres.

Suspension System: Objects of suspension systems rigid axle suspension system, torsion bar, shock absorber, independent suspension system. Chassis-Types-Body of automobile, ergonomics and anthropometry

UNIT – IV

Steering System: Steering geometry camber, castor, King pin rake, combined angle toe-in, center point steering. Steering gears types, steering linkages.

Braking System: Mechanical brake system, Hydraulic brake system, Disc and Drum type Brakes- Master cylinder, wheel cylinder, Requirements of brake fluid, Pneumatic, vacuum, parking and hand brakes.

UNIT – V

Pressure Changes in Engines Super chargers and turbo chargers

Emission from Automobiles Pollution standards National and international Pollution control Techniques. Noise pollution and controls. Energy Alternatives, Solar, Photo-Voltaic, hybrid vehicles

Text Book:

1. Automobile Engineering, Vol. 1 & Vol. 2 , Kirpal Singh, Standard Publishers Distributors Delhi

Reference Books:

1. Automotive Mechanics, G.B.S.Narang, Khanna Publishers
2. Automobile Engineering , Vol. 1 & Vol. 2 , K.M Gupta, Umesh publication
3. Automotive Mechanics , J.Heitner, CBS Publications
4. Automobile Engineering, William Crouse, TMHILL Publishers.

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ELECTRIC AND HYBRID VEHICLES (PROFESSIONAL ELECTIVE – IV)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

COURSE OUTCOMES: At the end of this course, students would be able to:

1. Get a good understanding of the basic functioning of both Electric and Hybrid vehicles and their performance
2. Develop a good concept of the electrical vehicle modeling and its power plant characteristics.
3. To understand the fundamentals of chargers related to both electric & hybrid vehicle operation & energy management.
4. Have a detailed understanding of electric propulsion systems, types of motors and the other important subsystems in Electric vehicles.
5. Have clear concepts of the different possible energy storage systems for both electric and hybrid vehicles.

UNIT-I: INTRODUCTION TO EV: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, Classification of EV. **ARCHITECTURE OF HEV:** Series HEV, Parallel HEV and Series-Parallel HEV, Power flow control in hybrid drive train topologies: Series hybrid drive train, Parallel hybrid drive train and Series-Parallel hybrid drive train

UNIT-II: FUNDAMENTALS OF ELECTRIC VEHICLES: General description of vehicle movement, Vehicle resistance: Rolling Resistance, Aerodynamic drag, Grading resistance, Dynamic Equation, Vehicle Transmission Characteristics: Manual gear transmission and Hydro dynamic transmission, Vehicle performance: Maximum Cruising Speed, Grade ability, Acceleration performance.

UNIT-III: PLUG-IN HYBRID ELECTRIC VEHICLES: Introduction, Functions and Benefits of PHEV, Operating Principles of Plug-in Hybrid Vehicle: Charge-Depleting Mode, Charge-Sustaining Mode, AER Mode, Engine-Maintenance Mode, Control Strategy of PHEV, PHEV-Related

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Technologies and Challenges **FUNDAMENTALS OF CHARGERS:** Charger Classification and Standards, Charger Requirements, Topology Selection for Level 1 and 2 AC Chargers: Front-End AC-DC Converter Topologies, Isolated DC-DC Converter Topologies, Wireless Chargers.

UNIT-IV: ELECTRIC PROPULSION SYSTEMS: Introduction to electric components used in HEV's, DC Motor drives: Combined armature and Field Control method, Chopper control DC drives, Multi quadrant control of Chopper fed DC drive. **PERMANENT MAGNET BLDC & SRM MOTOR DRIVES:** Closed loop Torque control of BLDC motor drive and Sensor-less Control of BLDC Motor drive using Back EMF method, Switch Reluctance Motor drives: Basic Magnetic structure, Modes of operation, different Inverter topologies of SRM drives.

UNIT-IV: ENERGY STORAGE: Introduction to Energy Storage Requirements in Electric Vehicles, Battery Parameters, Battery based energy storage: Lead acid battery, Lithium Ion Battery and Metal Air batteries, Super Capacitor based energy storage, Fuel Cell based energy storage, Hybridization of different energy storage device.

TEXT BOOKS:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.

REFERENCE BOOKS:

1. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. Ali Emadi, "Advanced Electrical Hybrid Vehicles" CRC Press, 2015, Taylor & Francis Group.
4. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.

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BASIC AUTOMOBILE ENGINEERING (OPEN ELECTIVE-III)

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understanding the basic structure of an automobile.
2. Evaluating different cooling and lubrication systems of an automobile
3. Analyzing the electrical systems in tandem with ignition systems
4. Understand various transmission and suspension systems.
5. Appraise steering and braking systems. Understand emission norms of automobiles.

UNIT-I

Introduction: Types of automobile engines.

S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump, filters, carburetor, types, air filters, petrol injection. M.P.F.I system

C.I. engines: Requirements of diesel injection systems, types of injection systems, Common Rail Diesel injection- fuel pump, nozzle, spray formation, injection timing.

UNIT-II

Engine Lubrication System: Splash and pressure lubrication systems.

Cooling System: Cooling requirements, Air cooling, liquid cooling, Thermo, Water and forced lubrication system, Radiators: Types, Cooling fans.

UNIT-III

Ignition System: Battery ignition system, Magneto coil ignition system, electronic ignition system. Battery, Contact breakers, Spark plugs.

Electrical System: Charging circuit, generator, current, voltage regulator, starting system, bendix drive mechanism solenoid switch, lighting system, Horn, Wiper, fuel gauge.

UNIT-IV

Transmission System: Clutches, types-cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches – gear boxes, types. Propeller shaft, Hotch- Kiss drive, Torque tube drive.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

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UNIT-V

Steering System: Steering geometry, camber, castor, King pin rake, combined angle toe-in, center point steering.

Braking System: Mechanical brake system, Hydraulic brake system, Disc and Drum type Brakes.

Emission from Automobiles: Pollution standards National and international, Pollution control Techniques. Noise pollution and controls.

Text Book:

1. Automobile Engineering ,Vol. 1 & Vol. 2, Kirpal Singh, Standard Publishers Distributors Delhi

Reference Books:

1. Automotive Mechanics, G.B.S. Narang, Khanna Publishers.
2. Automotive Mechanics, J. Heitner, CBS Publications.
3. Automobile Engineering , Vol. 1 & Vol. 2 , K.M Gupta, Umesh publication
4. Automobile Engineering, William Crouse, TMHILL Publishers.

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MAINTENANCE AND SAFETY ENGINEERING

B. Tech. IV Year I Semester- MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand the need for maintenance in an industry and know about Maintenance Management and Control.
2. Appreciate and implement various types of maintenance.
3. Know the concept of inventory control in maintenance.
4. Evaluate the quality and cost of safety and maintenance.
5. Appraise the concepts of reliability and maintainability with reference to the maintenance of equipment.

UNIT – I

Introduction: Need for Maintenance, Facts and Figures, Modern Maintenance, Problem and Maintenance strategy for the 21st Century Engineering Maintenance Objectives and Maintenance in Equipment Life cycle, Terms and Definitions.

Maintenance Management and Control: Maintenance Manual Maintenance, Facility Evaluation Functions of Effective Maintenance Management, Maintenance Project Control Methods, Maintenance Management Control indices.

UNIT – II

Types of Maintenance: Preventive Maintenance, Elements of Preventive, Maintenance Program, Establishing Preventive Maintenance Program, PM Program Evaluation and improvement, PM Measures, PM Models, Corrective Maintenance, Corrective Maintenance Types, Corrective Maintenance Steps and Downtime Components, Corrective Maintenance Measures, Corrective Maintenance Models.

UNIT – III

Inventory Control in Maintenance: Inventory Control Objectives and Basic inventory Decisions, ABC inventory Control Models Two Bin inventory Control and Safety Stock, spares Determination Factors spares calculation methods.

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UNIT – IV

Quality and Safety in Maintenance: Needs for Quality Maintenance Processes, Maintenance Work Quality, Use of Quality Control Charts in Maintenance Work Sampling, Post Maintenance Testing, Reasons for Safety Problems in Maintenance, Guidelines to improve Safety in Maintenance Work, Safety Officer's Role in Maintenance Work, Protection of Maintenance Workers.

Maintenance Costing: Reasons for Maintenance Costing, Maintenance Budget Preparation Methods and steps, Maintenance Labor Cost Estimation, Material Cost Estimation, Equipment Life Cycle Maintenance Cost Estimation, Maintenance Cost Estimation Models.

UNIT – V

Reliability, Reliability Centered Maintenance, RCM: Goals and Principles, RCM Process and Associated Questions, RCM Program Components Effectiveness Measurement indicators, RCM Benefits and Reasons for its Failures, Reliability Versus Maintenance and Reliability Measures and Formulas, Reliability Networks, Reliability Analysis Techniques.

Maintainability: Maintainability importance and Objective, Maintainability in Systems Life Cycle, Maintainability Design Characteristics, Maintainability Functions and Measures, Common Maintainability Design Errors.

Text Book:

1. Engineering Maintenance a modern approach, B. S. Dhallon, C.R.R Publishers

Reference Books:

1. Reliability, Maintenance and Safety Engineering, Dr. A.K Gupta, Laxmi Publications.
2. Reliability Engineering, Elsayed, Pearson
3. Industrial Safety Engineering, Garg, Danpathrai Publishers
4. Industrial Safety Management, L.M.Deshmukh, TMH





PROJECT STAGE-I

B. Tech. IV Year I Semester - MECH

L	T	P	C
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Course Outcomes:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation, and design engineering solutions.
3. Formulate the methodology of the proposed project and acquire necessary Materials, testing methods and evaluation procedures

The students in a group of 3 to 4 approved by the head of the department under the guidance of a faculty member shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work. Each student, under the guidance of a Faculty, is required to present the seminar on the selected project orally and/or through power point slides before a departmental project review committee. Answer the queries and involve in debate/discussion. Submit two hard copies as per the department guidelines. The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

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UNCONVENTIONAL MACHINING AND PROCESSES

B. Tech. IV Year II Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand the need, importance and classification of various unconventional machining processes.
2. Appreciate basic principles and process parameters of ultrasonic, water jet and abrasive jet machining processes.
3. Appreciate thermal energy based machining processes with emphasis on surface finish and accuracy.
4. Appraise different chemical material removal processes.
5. Understand electron beam machining and plasma arc machining along with applications.

UNIT-I

Introduction: Need for non-conventional machining processes, Classification of non-conventional machining processes, considerations in process selection, materials, general characteristics and applications of non-conventional machining processes, Historical development.

UNIT-II

Mechanical Material Removal Processes: Ultrasonic machining, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining: Basic principles, components, process variables, advantages and disadvantages, applications.

UNIT-III

Thermal Material Removal Processes: Electro Discharge Machining, Wire EDM, Laser Beam Machining, Electron Beam Machining, and Ion Beam Machining: Basic principles, components, process variables, advantages, limitations and applications.

UNIT-IV

Chemical Material Removal Processes: Electro Chemical Machining, Electro Chemical Grinding, Electro Chemical Honing, and Electro Chemical Deburring: Basic principles, components, process variables, advantages, limitations and applications.

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UNIT-V

Electron Beam Machining: Generation and control, Theory of electron beam machining, Comparison of thermal and non-thermal processes. General principle and application of laser beam machining – Thermal features, Cutting speed and accuracy of cut.

Plasma Arc Machining: Application of plasma for machining, metal removal mechanism, Process parameters, Accuracy and surface finish and other applications of plasma in manufacturing industries.

Text Book:

1. Advanced Machining Processes, VK Jain, Allied publishers.

Reference Books:

1. Modern Machining Process, Pandey P.C. and Shah H.S., TMH
2. MEMS & Microsystems – Design and Manufacture by Tai-Ran Hsu, Tata McGrawHill
3. New Technology by Bhattacharya A, the Institution of Engineers, India 1984.
4. Non-Traditional Machining, P.K. Mishra, New Age.

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PLANT LAYOUT AND MATERIAL HANDLING

B. Tech. IV Year II Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes

1. Understand different plant layouts, selection and comparison of process and product layouts.
2. Understand heuristics for plant layouts like ALDEP, CORELAP and CRAFT.
3. Get an overview of material handling systems and relationship between material handling and plant layout.
4. Appreciate various methods of material handling like path and function oriented systems.
5. Minimize cost of material handling with safety prerequisites.

UNIT-I

Introduction to plant layout

Classification of Layout, Advantages and Limitations of different layouts, Layout design procedures, Overview of the plant layout. Process layout & Product layout: Selection, specification, Implementation and follow up, comparison of product and process layout.

UNIT-II

Heuristics for Plant layout

ALDEP, CORELAP, CRAFT, Group Layout, Fixed position layout- Quadratic assignment model. Branch and bound method,

UNIT-III

Introduction to Material Handling

Material Handling systems, Material Handling principles, Classification of Material Handling Equipment, Relationship of material handling to plant layout.

UNIT-IV

Basic Material Handling systems

Selection, Material Handling method- path, Equipment, function oriented systems.

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UNIT-V

Methods to minimize cost of material handling- Maintenance of Material Handling Equipments, Safety in handling Ergonomics of Material Handling equipment. Design, Miscellaneous equipments.

TEXT BOOKS

1. Operations Management; PB Mahapatra/PHI-2010.

REFERENCES

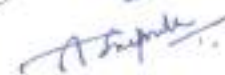
1. Facility Layout & Location an analytical approach: RL Francis, LF Mc Linnis Jr, White- PHI Second edition-1991.
2. Plant Layout and Material Handling: RB Chowdary- Khanna Publishers Second Edition-1986.
3. Plant Layout and Materials Handling/James M. Apple/ John Wiley & Sons; Third Edition-1978
4. Aspects of Material handling: Dr. KC Arora & Shinde/ Lakshmi Publications-2007.














POWER PLANT ENGINEERING

B. Tech. IV Year II Semester - MECH

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand the layout of steam power plant and know different handling systems. Appreciate the working principles of various components responsible for combustion.
2. Comprehend the layout of diesel power plant with detailed emphasis on its auxiliaries.
3. Know the working of hydroelectric power plants and characteristics of hydrographs.
4. Identify the advantages, disadvantages & applications of nuclear power plants.
5. Analyze and estimate different power plant economic factors and environmental considerations.

UNIT – I

Introduction to the Sources of Energy – Resources and Development of Power in India.

Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

Combustion Process: Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT – II

Internal Combustion Engine Plant: Diesel Power Plant: Introduction – IC Engines, types, construction – Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.

UNIT – III

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.

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

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UNIT – IV

Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. **Types of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT – V

Power Plant Economics and Environmental Considerations: 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. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

TEXT BOOKS:

1. Power Plant Engineering/ P. K. Nag / Mc Graw Hill

REFERENCES BOOKS:

1. Power Plant Engineering / Hegde / Pearson.
2. Power Plant Engineering / Gupta / PHI
3. Power Plant Engineering / A K Raja / New age



PROJECT STAGE-II including seminar

B. Tech. IV Year II Semester - MECH

L	T	P	C
0	0	22	9+2

Course Outcomes:

1. Design a system under the domain of mechanical engineering.
2. Develop a model comprising of real time application in the industry.
3. Evaluate for simulation design, analysis, manufacturing and testing the system built.

Each student of the project batch shall involve in carrying out the project work jointly under the guidance of a faculty member and prepare the project report after completing the work to the satisfaction of the internal guide. Each student, under the guidance of a Faculty, is required to present the seminar on the selected project orally and/or through power point slides. The progress of the project is evaluated by a departmental review committee. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.





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INDUSTRIAL ROBOTICS

B. Tech. III Year I Semester - MECH

L	T	P	C
4	0	0	4

UNIT 1: Introduction

Automation and its types, Definition of Robot, Historical background, Robotics and programmable automation, Laws of Robotics, Robot Anatomy, Components of robots, Classification of robots by configuration and control system, Applications of Robotics, Advantages and Limitations of Robots.

UNIT 2: End Effectors

Classification of end effectors, Types and working principles of grippers, General considerations of gripper selection and design, Different tools used as end effectors.

UNIT 3: Sensors & Actuators

Sensors: Classification of sensors, working principles of different types of sensors like position, velocity, tactile, proximity sensors etc.,

Actuators: Working principles, applications, advantages and limitations of Pneumatic, Hydraulic and Electric Actuators.

UNIT 4: Robot Programming

Methods of Robot Programming, Leadthrough Programming Methods, Motion Interpolation, Wait, Signal, and Delay Commands, Branching, Textual Robot Languages, Generations of Robot Programming Languages, Robot Language Structure.

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UNIT 5: Applications of Robots in the Industry

Robot Applications in Industry: Material handling applications like material transfer and machine load/unload operations, different processing applications of robots, Assembly & Inspection applications of robots in the industry, Future Applications of robots.

TEXT BOOKS:

1. Industrial Robotics, Groover M.P, Pearson Edu.

REFERENCES:

1. Robot Dynamics & Control, Mark W. Spong and M.Vidyasagar, John Wiley & Sons.
2. Introduction to Robotics, Analysis, Control and Applications, Saeed.B.Niku, Wiley.
3. Introduction to Robotic Mechanics and Control, JJ Craig, Pearson.
4. Robotic Engineering, Richard D. Klafter, Prentice Hall.



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ADDITIVE MANUFACTURING

B. Tech. III Year II Semester - MECH

L	T	P	C
4	0	0	4

UNIT – I

Introduction: Prototyping fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies.

UNIT – II

Liquid-Based AM Systems: Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid Ground Curing (SGC): Models and Specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Polyjet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case studies. Micro fabrication.

Solid-Based AM Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

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UNIT – III

Powder Based AM Systems: Selective Laser Sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Three Dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. **Laser Engineered Net Shaping (LENS):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Electron Beam Melting (EBM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT, Rapid

Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT – IV

AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques.

AM Software's: Need for AM software, Features of various AM software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, MeshLab.

UNIT – V

AM Applications: Application Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customised Implants & Prosthesis, Design and



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Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules, Web Based Rapid Prototyping Systems

TEXT BOOKS:

1. Rapid Prototyping: Principles and Applications Chua C.K., Leong, World Scientific Publishing Co Pvt. Ltd

REFERENCES:

1. Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou L.W. and Liou F.W, CRC Press, 2007.
2. Rapid Prototyping & Engineering Applications, Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.
3. Rapid Prototyping, K.F. and LIM C.S, World Scientific publications, Third Edition, 2010.
4. Wohlers Report 2000 – Terry Wohlers, Wohlers Associates, 2000

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SWAYAM COURSE EQUIVALENT TO ADDITIVE MANUFACTURING

FUNDAMENTALS OF ADDITIVE MANUFACTURING TECHNOLOGIES

By Prof. Sajjan Kapil | IIT Guwahati

B. Tech. III Year II Semester - MECH

L	T	P	C
4	0	0	4

Course layout

- Week 1: Introduction to Additive Manufacturing
- Week 2: Computer Aided Process Planning for Additive Manufacturing
- Week 3: Computer Aided Process Planning for Additive Manufacturing
- Week 4: Liquid Additive Manufacturing
- Week 5: Liquid Additive Manufacturing
- Week 6: Sheet Additive Manufacturing
- Week 7: Wire Additive Manufacturing
- Week 8: Wire Additive Manufacturing
- Week 9: Wire Additive Manufacturing
- Week 10: Powder Additive Manufacturing
- Week 11: Powder Additive Manufacturing
- Week 12: Powder Additive Manufacturing

TEXT BOOKS:

1. Venuvinod, Patri K., and Weiyin Ma. Rapid prototyping: laser-based and other technologies. Springer Science & Business Media, 2013.

REFERENCES

1. Ian Gibson, David Rosen, and Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, NY, 2015.
2. Kumar, L. Jyothish, Pulak M. Pandey, and David Ian Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.
3. Jacobs, Paul F. "Fundamentals of stereolithography." In 1992 International Solid Freeform Fabrication Symposium. 1992.



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ROBOTIC SIMULATION & 3D PRINTING LABORATORY

B. Tech. III Year II Semester - MECH

L	T	P	C
0	0	3	1.5

1. Study of different actuators and end effectors for robot.
2. Robot Programming with Computer Simulation Software.
3. Modeling of 2D and 3D Robot.
4. Simulation of Planar Robotic motion
5. Simulation of 3D Robotic motion
6. Solving Robot Arm Kinematics with Matlab
 - a) Matrix multiplication and Concatenation of matrices in matlab, inverse of a matrix. To solve different transformation matrices, to find the homogeneous transformation matrix of robotic manipulator, to find the joint angles when the end effectors position is given.
 - b) Robot workspace: Plot of end effectors position vector in three-dimensional space.
7. 3-D printing of a typical engineering component.

Note: Robotic Simulation Software CoppeliaSim is employed for simulation.

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ADVANCED FINITE ELEMENT METHOD

B. Tech. IV Year I Semester - MECH

L	T	P	C
3	0	0	3

UNIT-I:

Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin's Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain- displacement relations.

UNIT-II:

1-D Structural Problems: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.

Analysis of Trusses: Plane Trusses and Space Truss elements and problems

Analysis of CAD/CAM: Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT-III:

2-D problems: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration. Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.

3-D Problems: Tetrahedran element – Jacobian matrix – Stiffness matrix.

UNIT-VI:

Scalar Field Problems: 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems – Introduction to Torsional problems.

UNIT-V:

Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

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TEXT BOOKS:

1. Finite Element Methods: Basic Concepts and applications, Alavala, PHI.

REFERENCES:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
3. Introduction to Finite element analysis- S.Md.Jalaludeen, Anuradha Publications, print-2012
4. Finite Element Method – Zienkiewicz / Mc Graw Hill

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TECHNICAL PAPER WRITING

B. Tech. IV Year I Semester - MECH

L	T	P	C
0	0	4	2

In the technical paper writing the student is expected to follow the principles of presenting the abstract, literature review, methodology, results & discussion, and conclusions as per the standards followed in various peer reviewed journals. The content is well documented following the English grammar and plagiarism checks called for during the course. The students individually communicate a technical paper of respective domains of mechanical engineering by the end of evaluation. Head of the department forms a committee with three teachers to evaluate the course under consideration.

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ADVANCED CAD

B. Tech. IV Year II Semester - MECH

L	T	P	C
4	0	0	4

UNIT- I:

CAD Tools: Definition of CAD Tools, Graphics standards, Graphics software: requirements of graphics software, Functional areas of CAD, Efficient use of CAD software.

Basics of Geometric Modelling: Requirement of geometric modelling, Geometric models, Geometric construction methods, Modelling facilities desired.

UNIT- II:

Geometric modelling: Classification of wireframe entities, Curve representation methods, Parametric representation of analytic curves: line, circle, arc, conics, Parametric representation of synthetic curves: Hermite cubic curve, Bezier curve, B-Spline curve wire, NURBS, Curve manipulations.

UNIT- III:

Surface Modeling : Classification of surface entities, Surface representation methods, Parametric representation of analytic surfaces: plane surface, ruled surface, surface of revolution, tabulated cylinder, Parametric representation of synthetic curves: Hermite cubic surface, Bezier surface, B-Spline surface, Blending surface, Surface manipulations.

UNIT- IV:

Solid Modelling: Geometry and topology, Boundary representation, The Euler-Poincare formula, Euler operators, Constructive solid geometry: CSG primitives, Boolean operators, CSG expressions, Interior, Exterior, closure, Sweeping: linear and non-linear, Solid manipulations.

UNIT- V:

Transformations: 2-D and 3-D transformations: translation, scaling, rotation, reflection, concatenation, homogeneous coordinates, Perspective projection, orthotropic projection, isometric projection, Hidden surface removal, shading, rendering.

Evaluation Criteria: Evaluation criteria of CAD software, Data exchange formats: GKS, IGES, PHIGS, CGM, STEP

Dimensioning and tolerances: Linear, angular, angular dimensions, maximum

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material condition (MMC), Least material condition (LMC), Regardless of feature size (RFS).

TEXT BOOKS:

1. CAD/CAM Concepts and Applications/ Alavala/ PHI.

REFERENCES :

1. CAD/CAM Principles and Applications/ P.N.Rao/TMH/3rd Edition
2. CAD/CAM /Groover M.P./ Pearson education
3. CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age
4. Mastering CAD/CAM / Ibrahim Zeid / Mc Graw Hill International.

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CAD/CAM /CAE LABORATORY

B. Tech. IV Year II Semester - MECH

L	T	P	C
0	0	3	1.5

Features and selection of CNC turning and milling centers. Practice in part programming and operation of CNC turning machines, subroutine techniques and use of cycles. Practice in part programming and operating a machining center, tool panning and selection of sequences of operations, tool setting on machine, practice in APT based NC programming, preparation of various reports and route sheets, Simulation of manufacturing system using CAM software, controller operating system commands.

MODELING

1. Surface modeling.
2. Solid modeling.
3. Drafting.
4. Assembling.

ANALYSIS OF STRUCTURES USING FEA PACKAGES

1. Static Analysis.
2. Modal Analysis.
3. Harmonic Analysis.
4. Spectrum Analysis.
5. Buckling Analysis.
6. Analysis of Composites.
7. Fracture mechanics.
8. Transient analysis

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PRINCIPLES OF ROBOTICS

B. Tech. III Year I Semester

L	T	P	C
3	0	0	3

UNIT 1: Introduction

Automation and its types, Definition of Robot, Historical background, Robotics and programmable automation, Laws of Robotics, Robot Anatomy, Components of robots, Classification of robots by configuration and control system, Applications of Robotics, Advantages and Limitations of Robots.

UNIT 2: End Effectors

Classification of end effectors, Types and working principles of grippers, General considerations of gripper selection and design, Different tools used as end effectors.

UNIT 3: Sensors

Sensors: Classification of sensors, working principles of different types of sensors like position, velocity, tactile, proximity sensors etc., Introduction to Machine Vision, applications of machine vision in robotics.

UNIT 4: Actuators

Working principles, applications, advantages and limitations of Pneumatic, Hydraulic and Electric Actuators.

UNIT 5: Robot Programming

Methods of Robot Programming, Leadthrough Programming Methods, Motion Interpolation, Wait, Signal, and Delay Commands, Branching, Textual Robot

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Languages, Generations of Robot Programming Languages, Robot Language Structure.

TEXT BOOKS:

1. Industrial Robotics, Groover M.P, Pearson Edu.
2. Introduction to Robotic Mechanics and Control, JJ Craig, Pearson.

REFERENCES:

1. Robot Dynamics & Control, Mark W. Spong and M.Vidyasagar, John Wiley & Sons.
2. Introduction to Robotics, Analysis, Control and Applications, Saeed.B.Niku, Wiley.
3. Robotics, Fu K.S, McGraw Hill.
4. Robotic Engineering, Richard D, Klafter, Prentice Hall.

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SCILAB FOR ROBOTICS LAB

B. Tech. III Year I Semester

L	T	P	C
0	0	3	1.5

List of Experiments

1. Study of basic SCILAB commands
2. Matrix constructors and operations
3. Matrix bitwise, relational & logical operations
4. Mathematical functions in SCILAB.
5. Control structures (if-else, if-elseif-else, select)
6. Control structures (for, while, break and continue)
7. Solving Robot Arm Kinematics problems.
 - a. Matrix multiplication and Concatenation of matrices in matlab, inverse of a matrix.
 - b. To solve different transformation matrices,
 - c. To find the homogeneous transformation matrix of robotic manipulator,
 - d. To find the joint angles when the end effector position is given.

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MICRO CONTROLLERS FOR ROBOTICS

B. Tech. III Year II Semester

L	T	P	C
3	0	0	3

Course Outcomes:

1. Understand the architecture of 8051 controllers
2. Remember different types of addressing modes
3. Analyze the different instructions and applications in writing delay
4. Understand the interfacing of different peripherals with Microcontrollers
5. Analyze the different Actuators and display devices with microcontrollers

UNIT-I: 8051 Microcontroller

Definition of embedded system and its characteristics - Role of microcontrollers in embedded Systems – Comparison Microprocessor & Microcontrollers

The 8051 Architecture: Internal Block Diagram - CPU - ALU - address - data and control bus - working registers - SFRs - Clock and RESET circuits - Stack and Stack Pointer - Program Counter.

UNIT-II: Addressing Modes

I/O ports - Memory Structures - Data and Program Memory - Timing diagrams and Execution Cycles.

Addressing modes: Introduction - Instruction syntax - Data types - Subroutines Immediate addressing - Register addressing - Direct addressing - Indirect addressing - Relative addressing - Indexed addressing - Bit inherent addressing - bit direct addressing.

UNIT-III: Instruction set

8051 Instruction set - Instruction timings. Data transfer instructions Arithmetic instructions - Logical instructions - Branch instructions - Subroutine instructions - Bit manipulation instruction. Assembly language programs -

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UNIT-IV: Interfacing - I

Interfacing of peripheral - ADC - DAC - timers - counters -. RS232 - SPI - I2C.
Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

UNIT-V: Interfacing – II

LED – LCD and keyboard interfacing- Stepper motor interfacing – DC Motor interfacing – servo Motor interfacing.

TEXT BOOKS:

1. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2007.
2. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2005.

REFERENCE BOOKS:

1. R. Kamal, "Embedded System", McGraw Hill Education, 2009.
2. Steve Furber, "ARM System – On – Chip architecture", Addison Wesley, 2000

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ADVANCED ROBOTICS

Year IV-I Semester

L	T	P	C
4	0	0	4

UNIT-1: Motion Analysis

Representation of a point, vector, frame and rigid body in space, translation and rotation matrices, combined transformations, homogeneous transformations, Problems on transformations

UNIT-2: Kinematics of Position

Representation in Joint and world coordinates, Forward and Inverse kinematics, Forward and Inverse Kinematic equations for plane R-R manipulator using geometric approach, Forward and inverse kinematic equations of position for Cartesian, cylindrical and spherical robots.

UNIT-3: Kinematics of Orientation and Differential Kinematics

Kinematic equations of orientation using RPY and Euler approaches – Problems,
Introduction to differential kinematics of robots, Differential kinematic equations
for robots, problems on differential transformations.

UNIT-4: Trajectory Planning

Difference between path and trajectory, Joint space and Cartesian Space Trajectory Planning, Slew motion, Joint Interpolated motion and Straight line motion, Problems on cubic polynomial fit.

B. S. Baran Radwan Atany K HR BK Ashpulen



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UNIT-5: Robot Cell Design

Robot workcell layouts: Robot-centered cell, inline robot cell and mobile robot cell layouts, Considerations in workcell design

TEXT BOOKS:

1. Industrial Robotics (Technology, Programming and Applications), Mikell P. Groover, Tata McGraw Hill Education Private Limited.
2. Introduction to Robotics: Analysis, Control and Applications, Saeed Benjamin Niku, John Wiley & Sons.

REFERENCES:

1. Robotics and Control, R.K. Mittal & I.J. Nagrath, Tata McGraw Hill Publishing Company Limited.
2. Introduction to Robotics: Mechanics and Control, John J. Craig, Pearson Education International.
3. Robotics: Control, Sensing, Vision and Intelligence, K.S.Fu, R.C.Gonzalez & C.S.G.Lee, McGraw Hill Education.

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SWAYAM COURSE EQUIVALENT TO ADVANCED ROBOTICS

INTRODUCTION TO ROBOTICS

By Prof. Asokan T, Prof. Balaraman Ravindran, Prof. Krishna Vasudevan | IIT Madras

ABOUT THE COURSE:

This course is a bridge-course for students from various disciplines to get the basic understanding of robotics. The mechanical, electrical, and computer science aspects of robotics is covered in this introductory course.

INTENDED AUDIENCE : Undergraduate/graduate students interested in robotics.

Summary

Course Type :	Core
Category :	- Design Engineering - Robotics
Credit Points :	3
Level :	Undergraduate/Postgraduate

Course layout

Week 1: Introduction to robotics- History, growth; Robot applications- Manufacturing industry, defense, rehabilitation, medical etc., Laws of Robotics

Week 2: Robot mechanisms; Kinematics- coordinate transformations, DH parameters

Week 3: Forward kinematics, Inverse Kinematics

Week 4: Jacobians, Statics, Trajectory Planning

Week 5: Actuators (electrical)- DC motors, BLDC servo motors

Week 6: Sensors, sensor integration

Week 7: Control – PWM, joint motion control, feedback control

Week 8: Computed torque control

Week 9: Perception, Localisation and mapping

Week 10: Probabilistic robotics, Path planning, BFS; DFS; Dijkstra; A-star; D-star; Voronoi; Potential Field; Hybrid approaches

Week 11: Simultaneous Localization and Mapping

Week 12: Introduction to Reinforcement Learning

Books and references

1. Robert J Schilling, Fundamentals of Robotics, Prentice Hall India, 200
2. John J Craig, Introduction to Robotics, Prentice Hall International, 2005

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ROBOTIC SIMULATION LAB

B. Tech. IV Year I Semester

L	T	P	C
0	0	3	1.5

List of Experiments

1. Study of different actuators and end-effector for robot.
2. Robot Programming with Computer Simulation Software.
3. Programming of robots by manual, lead through and off-line methods,
4. use of robot programming languages to pick and place,
5. stacking of objects in increasing or decreasing size,
6. Palletizing operations, assembly and inspection operation etc.
7. Robot workspace: Plot of end effector position vector in three-dimensional space.

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IMPLEMENTATION OF ROBOTIC SYSTEMS

Year IV-Semester II

L	T	P	C
3	0	0	3

UNIT 1: Applications of Robots in the Industry

Robot Applications in Industry: Material handling applications like material transfer and machine load/unload operations, different processing applications of robots, Assembly & Inspection applications of robots in the industry, Future Applications of robots in manufacturing.

UNIT 2: Artificial intelligence of robots

Introduction to Artificial intelligence, Importance and applications of Artificial Intelligence in manufacturing, Goals of Artificial Intelligence research, techniques in Artificial Intelligence, Artificial Intelligence and Robotics, three primitives for organizing intelligence in robotics.

UNIT 3: Safety, training, maintenance, and quality

Safety aspects in robotics, importance of robotics training, Hinson's five categories of robotics training, maintenance: maintenance staff, preventive maintenance, quality improvement.

UNIT 4: Economic analysis for robotics

Data required for economic analysis for robotics, methods of economic analysis - payback method, equivalent uniform annual cost method, return on investment (ROI) method, subsequent use of the robot, factors that cannot be quantified.

UNIT 5: Robotics technology of the future

Robot intelligence, advanced sensor capabilities, mobility, locomotion, and navigation, the universal hand, generations of robots, future generation robot capabilities, other applications of robots in medical and house hold application.

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TEXT BOOKS:

1. Industrial Robotics (Technology, Programming and Applications), Mikell P. Groover, Tata McGraw Hill Education Private Limited.

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2. Introduction to Robotics: Mechanics and Control, John J. Craig, Pearson Education International.
3. Robotics: Control, Sensing, Vision and Intelligence, K.S.Fu, R.C.Gonzalez & C.S.G.Lee, McGraw Hill Education.

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MINI PROJECT

Year IV-Semester II

L	T	P	C
0	0	4	2

The students in a group of 4 to 5 works on an industry oriented topic approved by the head of the department and prepare a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.