

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

| Sr. No.                                           | Subject                                             | Code     | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---------------------------------------------------|-----------------------------------------------------|----------|--------------|----------------|--------------------------------------|
| <b>Fifth Semester (3<sup>rd</sup> year of UG)</b> |                                                     |          |              |                |                                      |
| 1.                                                | Thermal Power Plant                                 | ME301    | 3-1-0        | 4              | 70                                   |
| 2.                                                | Tribology and Mechanical Vibration                  | ME303    | 3-0-2        | 4              | 85                                   |
| 3.                                                | Machining Processes                                 | ME305    | 3-0-2        | 4              | 85                                   |
| 4.                                                | Fundamentals of Machine Design                      | ME307    | 3-1-2        | 5*             | 100                                  |
| 5.                                                | Institute Elective – I                              | ME35x    | 3-0-0        | 3              | 55                                   |
|                                                   |                                                     |          | <b>Total</b> | <b>20</b>      | <b>395</b>                           |
| 6.                                                | Minor/Honor                                         | M/HME XX | 3-1-0        | 4              | 70                                   |
| 7.                                                | Vocational / Professional Mechanical Practice – III | MEv05    | 0-0-8        | 5              | 200 (20 x 10)                        |

## (List of Elective / Honors / Minors)

| Sr. No.                                      | Electives                                         | Code  |
|----------------------------------------------|---------------------------------------------------|-------|
| <b>Institute Elective - I [Semester - V]</b> |                                                   |       |
| 1                                            | Mechanics of Solids                               | ME351 |
| 2                                            | Smart Materials and Structures                    | ME353 |
| 3                                            | Bio-Mechanics                                     | ME355 |
| 4                                            | Computational Fluid Dynamics                      | ME357 |
| 5                                            | Elements of Micro hydro plant and Pumping Systems | ME359 |
| 6                                            | Renewable Energy                                  | ME361 |
| 7                                            | Additive Manufacturing                            | ME363 |
| 8                                            | Powder Processing Techniques                      | ME365 |
| 9                                            | Production Planning & Control                     | ME367 |
|                                              | <b>Honors</b>                                     |       |
| 1                                            | Analysis and Synthesis of Mechanisms              | MEHD2 |
| 2                                            | Advanced Heat Transfer                            | MEHT2 |
| 3                                            | Industry 5.0                                      | MEHM2 |
| 4                                            | Electric Vehicles and Energy Storage Systems      | MEHE2 |
|                                              | <b>Minors</b>                                     |       |
| 1                                            | Thermal & Fluid Engineering                       | MEM32 |



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|                                                                               |        |   |   |   |        |
|-------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br><b>THERMAL POWER PLANT</b><br><b>ME301</b> | Scheme | L | T | P | Credit |
|                                                                               |        | 3 | 1 | 0 | 04     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                                               |
|-----|-------------------------------------------------------------------------------|
| CO1 | Apply thermodynamic cycles to steam and gas power plant                       |
| CO2 | Analyze the co-generation and combined cycles                                 |
| CO3 | Analyse the performance of steam generators and steam nozzle                  |
| CO4 | Evaluate the efficiency and losses of steam turbine                           |
| CO5 | Perform heat mass balance of steam condensers and cooling towers              |
| CO6 | Understand the working of fuel/Air handling unit and economics of power plant |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                   |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                   |
|    | <b>THERMODYNAMIC CYCLES FOR THERMAL POWER PLANTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>(12 hours)</b> |
|    | Review of Thermodynamic, Simple steam power cycle, Carnot cycle, Simple Rankine cycle, Reheat Rankine cycle, Regenerative Rankine cycle, Reheat -regenerative Rankine cycle, Brayton/gas cycle, Combined gas–vapor power cycle, Heat rate component of gas turbine and steam generation in heat recovery steam generator, Binary Vapor cycle ,Co-generation cycle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |
|    | <b>ELEMENTS OF THERMAL POWER PLANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>(22 hours)</b> |
|    | <p>Steam Generators: Types of boiling – Nucleate/Film boiling, Natural/Force circulation, Circulation ratio/Evaporation ratio, Types of Boilers – (a) Fuel (b) Operation (c) Pressure mode, Boiler pressure parts, Boiler mountings and safety devices.</p> <p>Steam Nozzles: Introduction, Types of nozzles, Flow of steam through nozzles, Expansion of steam considering friction, Nozzle efficiency, Super-saturated flow through nozzle.</p> <p>Steam Turbines: Impulse Turbine: Working principle, Forces on blades, Velocity diagrams, efficiency of multi stage turbine, Specific speed and performance characteristic curves for impulse turbine. Impulse Reaction Turbine: Working principle, Degree of reaction, Compounding of pressure and velocity, Isentropic and cylinder wise steam turbine efficiency, Dryness fraction and degree of superheat, Heat rate calculation, Bleed and extraction of steam from turbine, Heat and mass balance of steam turbine.</p> |                   |





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|  |                                                                                                                                                                                                                                                                                                                                                                                              |                   |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Steam Condensers: Types – (a) Surface (b) Jet (c) Air cooled condenser, Vacuum calculation, Vacuum efficiency, Ejector application, Heat mass balance of steam condenser. Cooling Towers: Types – (a) Natural Draft (b) Force Draft, Evaporation losses, Drift losses, Makeup and blow down calculation, Cooling Tower structures – louvers/fins, risers and sump and basin area calculation |                   |
|  | <b>WORKING UNITS OF POWER PLANT</b>                                                                                                                                                                                                                                                                                                                                                          | <b>(06 hours)</b> |
|  | Fuel and Air handling unit, Types of the fuel –Coal/Biomass/Natural Gas, Air-FD Fan, PA Fan, ID Fan, Ash handling unit, Open conveyer/closed shell type arrangement, hopper, Feed water handling unit, Feed water circuit, quality parameter, LP Dosing, Deaerator application                                                                                                               |                   |
|  | <b>POWER PLANT ECONOMICS</b>                                                                                                                                                                                                                                                                                                                                                                 | <b>(05 hours)</b> |
|  | Basic economics of power plant as fuel input, Tariff structure in India – KWH, KVA, Power factor, penalty of low generation, other taxes as per Central Electricity Authority (CEA), CEA guidelines for power trading through Indian Energy Exchange (IEX) and Real Time Market (RTM), Capital expenditures (Cpex) and Operating expenses (Opex) and power trading in block structure.       |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                      |                   |

|                             |                                                                                                                  |
|-----------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>3. Books Recommended</b> |                                                                                                                  |
| 1                           | S. Domkundwar, C.P. Kothandaraman and A.V. Domkundwar, A Course in Thermal Engineering, Dhanpat Rai and Co, 2018 |
| 2                           | P.K. Nag, Power Plant Engineering, Tata McGraw Hill Publications, 2017                                           |
| 3                           | P.K Das & A.K Das, An Introduction to Thermal Power Plant Engineering and Operation, Notion Press, 2018          |
| 4                           | Y.A. Cengel and M.A. Boles, Thermodynamics, Tata McGraw Hill, 2017                                               |
| 5                           | R. K. Rajput, Thermal Engineering, Laxmi Publications, 2017                                                      |



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| B.Tech. III (DoME) Semester – 5<br>TRIBOLOGY AND MECHANICAL VIBRATION<br>ME303 | Scheme | L | T | P | Credit |
|--------------------------------------------------------------------------------|--------|---|---|---|--------|
|                                                                                |        | 3 | 0 | 2 | 04     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                |
|-----|--------------------------------------------------------------------------------|
| CO1 | Get the knowledge of fundamental of tribology and its importance               |
| CO2 | Ability to understand the laws of friction & different types of wear           |
| CO3 | Cognize the different lubrication regimes and its applications.                |
| CO4 | Understand different methods to determine natural frequency of systems         |
| CO5 | Evaluate natural frequencies for Free Damped linear and torsional Systems      |
| CO6 | Investigate the frequencies for Forced Vibration linear and rotational Systems |

|    |                                                                                                                                                                                                                                                                 |            |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | <b>Syllabus</b>                                                                                                                                                                                                                                                 |            |
|    | <b>INTRODUCTION</b>                                                                                                                                                                                                                                             | (05 Hours) |
|    | Tribology, Types of engineering contacts: conforming and non-conforming, Surface interactions and characterization, micro and nano tribology, surface roughness measurement techniques, surface energy and flash temperature theory                             |            |
|    | <b>THEORIES OF FRICTION</b>                                                                                                                                                                                                                                     | (05 Hours) |
|    | Types of friction, Laws of sliding friction, concept of adhesion, Models of asperity deformation, measurement of friction, friction of metals ceramics and Polymers                                                                                             |            |
|    | <b>WEAR</b>                                                                                                                                                                                                                                                     | (05 Hours) |
|    | Types of wear, , Archard's law, wear mechanism adhesive wear, abrasive wear, erosion wear, factors affecting corrosive wear, wear map, various wear testing methods- pin on disc, pin on drum, slurry wear, air jet and water jet erosion as per ASTM standards |            |
|    | <b>LUBRICATION</b>                                                                                                                                                                                                                                              | (06 Hours) |
|    | Types of lubrication, viscosity, characteristics of fluids as lubricant, hydrodynamic lubrication, Reynold's equation, elastohydrodynamic lubrication- partial and mixed, boundary lubrication, various additives, solid lubrication                            |            |
|    | <b>FUNDAMENTAL OF VIBRATIONS</b>                                                                                                                                                                                                                                | (03 Hours) |





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|  |                                                                                                                                                                                                                                                                                                                     |                   |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Introduction, definition, SHM, beats phenomenon, complex method of representing harmonic vibration.                                                                                                                                                                                                                 |                   |
|  | <b>UNDAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEM</b>                                                                                                                                                                                                                                                  | <b>(06 Hours)</b> |
|  | Introduction, derivation of differential equations and resolution, equivalent stiffness of spring combinations, Newton's method and energy method for problem solutions                                                                                                                                             |                   |
|  | <b>DAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEM</b>                                                                                                                                                                                                                                                    | <b>(06 Hours)</b> |
|  | Different types of damping, free vibrations with viscous dampers                                                                                                                                                                                                                                                    |                   |
|  | <b>FORCED VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEMS</b>                                                                                                                                                                                                                                                         | <b>(09 Hours)</b> |
|  | Forced vibration with constant harmonic excitation, with rotating and reciprocating unbalance, due to the support, vibration isolation and transmissibility, measuring instruments, displacement, velocity, acceleration, frequency-measuring instruments, critical speed of shaft having single and multiple disc. |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                             |                   |

|           |                                                                             |
|-----------|-----------------------------------------------------------------------------|
| <b>3.</b> | <b>Practical</b>                                                            |
| 1         | Tuned rectilinear vibration absorber                                        |
| 2         | Rectilinear vibration of cantilever beam                                    |
| 3         | Free damped vibration                                                       |
| 4         | Fixed free three rotor system                                               |
| 5         | To determine the viscosity by using falling ball viscometer                 |
| 6         | Demonstrate friction and wear measurement on pin on disc apparatus          |
| 7         | Demonstrate the coefficient of friction measurement on reciprocation motion |
| 8         | Performance of Journal bearing test rig                                     |
| 9         | To measure the surface roughness using profile-meter                        |

|           |                                                                                        |
|-----------|----------------------------------------------------------------------------------------|
| <b>4.</b> | <b>Books Recommended</b>                                                               |
| 1         | Bharat Bhushan, Principles and Applications of Tribology, John Wiley & Sons, Ltd, 2013 |
| 2         | B. C Majmudar, Introduction to Tribology of Bearings, S Chand & Company, 2010          |
| 3         | Fundamentals of Tribology Basu & Sengupta, PHL, learning Pvt. LTD, New Delhi, 2015     |
| 4         | S. S. Rao, Mechanical Vibrations, Pearson Education, 6th Edition, 2018.                |
| 5         | G. K. Grover, Mechanical Vibrations, Nem Chand & Bros, 2009.                           |



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|------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br><b>MACHINING PROCESSES</b><br>ME305 | Scheme | L | T | P | Credit |
|                                                                        |        | 3 | 0 | 2 | 04     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

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|-----|--------------------------------------------------------------------------------------------------------------------|
| CO1 | Explain mechanics of chip formation and types of chips.                                                            |
| CO2 | Demonstrate relationship between chip formation and generation of stress, strain, force and wear.                  |
| CO3 | Describe conventional machining processes, geometry of cutting tools, and mechanism of conventional machine tools. |
| CO4 | Select machining process (es), cutting tool (s) and machine tool (s) to produce a given part.                      |
| CO5 | Calculate machining time incurred in machining a part if machining parameters and part dimensions are given.       |
| CO6 | Illustrate working principle and machine setup of unconventional machining processes.                              |

|    |                                                                                                                                                                                                                                                                                  |                   |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                         |                   |
|    | <b>MECHANICS OF MACHINING</b>                                                                                                                                                                                                                                                    | <b>(12 hours)</b> |
|    | Mechanism of chip formation, types of chips, chip breakers, Merchant circle diagram, cutting forces and power, tool wear and tool life; machinability; economics of machining; cutting tool materials; types of tools.                                                           |                   |
|    | <b>CONVENTIONAL MACHINING PROCESSES</b>                                                                                                                                                                                                                                          | <b>(16 hours)</b> |
|    | Introduction to Turning, shaping, planing, milling, drilling, broaching processes; types of machines and operations; different mechanisms on the machine; tool and work holding devices; special attachments; capstan and turret machine; automats; machining time calculations. |                   |
|    | <b>FINISHING PROCESSES</b>                                                                                                                                                                                                                                                       | <b>(06 hours)</b> |
|    | Introduction to grinding, types of machines and operations, dressing and trueing, glazing, designating system, selection of grinding wheel, lapping, honing, super finishing processes.                                                                                          |                   |
|    | <b>THREAD AND GEAR MANUFACTURING PROCESSES</b>                                                                                                                                                                                                                                   | <b>(05 hours)</b> |





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|--|--------------------------------------------------------------------------------------------------|-------------------|
|  | Thread manufacturing by thread milling and thread grinding. Gear milling, hobbing and finishing. |                   |
|  | <b>INTRODUCTION TO UNCONVENTIONAL MACHINING PROCESSES</b>                                        | <b>(06 hours)</b> |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                          |                   |

|           |                                                                                                   |
|-----------|---------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Practical</b>                                                                                  |
| 1         | Machining Practices on lathe for step turning, taper turning, grooving, thread cutting operations |
| 2         | Machining practices on shaping and drilling machine                                               |
| 3         | Machining practices on milling machine to cut spur or helical gear                                |
| 4         | Calculation of shear plane angle under different machining conditions                             |
| 5         | Measurement of chip tool interface temperature under different machining conditions               |
| 6         | Grinding Practice of single point cutting tool and measure tool angles                            |
| 7         | Demonstration of Capstan lathe                                                                    |
| 8         | Demonstration of EDM process                                                                      |

|           |                                                                                                                                                        |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4.</b> | <b>Books Recommended</b>                                                                                                                               |
| 1         | S. K. Hajra Choudhury, Element of Workshop Technology; Vol. 2, 14 <sup>th</sup> Edition, Media Promoters and publishers Pvt., 2010                     |
| 2         | V. K. Jain, Advanced machining processes; Allied publishers, 2009                                                                                      |
| 3         | A. B. Chattopadhyay, Machining and Machine Tools; 2 <sup>nd</sup> Edition, John Wiley & Sons, 2017                                                     |
| 4         | Kalpajian, S. and Illinois, S. R., Manufacturing Engineering and Technology; 6 <sup>th</sup> Edition, Pearson Prentice Hall, New Jersey, 2010          |
| 5         | M.P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems; 3 <sup>rd</sup> Edition, Wiley India Pvt. Ltd., New Delhi, 2012 |



|                                                                                   |        |   |   |   |        |
|-----------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br><b>FUNDAMENTALS OF MACHINE DESIGN</b><br>ME307 | Scheme | L | T | P | Credit |
|                                                                                   |        | 3 | 1 | 2 | 05     |

**1. Course Outcomes (COs):**

**At the end of the course, students will be able to**

|     |                                                                       |
|-----|-----------------------------------------------------------------------|
| CO1 | Describe the basic principles of machine design considerations.       |
| CO2 | Understand the theories of failure.                                   |
| CO3 | Estimate the life of machine components subjected to dynamic loading. |
| CO4 | Design the various types of joints and fasteners.                     |
| CO5 | Design the shafts and its components.                                 |
| CO6 | Evaluate the design of various types of mechanical springs.           |

|           |                                                                                                                                                                                                                                                                                                                                        |                   |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                        |                   |
|           | <b>DESIGN CONSIDERATIONS</b>                                                                                                                                                                                                                                                                                                           | <b>(04 Hours)</b> |
|           | Introduction to design procedure, design requirements and material selection, standardization, limits, fits and tolerance as per I.S. specification, review of force analysis concepts, factor of safety, mitigation of stress concentration.                                                                                          |                   |
|           | <b>DESIGN ANALYSIS</b>                                                                                                                                                                                                                                                                                                                 | <b>(08 Hours)</b> |
|           | Types of loads and stresses. parts subjected to tension, compression, shear, bending and torsion – such as tie rods, push rods, levers, axels etc. parts subjected to combined loads, combined stresses, Mohr's circle diagram, theories of failure, stresses in thin and thick cylinders, shrink fitted and press fitted connections. |                   |
|           | <b>DYNAMIC LOADING</b>                                                                                                                                                                                                                                                                                                                 | <b>(07 Hours)</b> |
|           | Cyclic loading, endurance limit, fatigue failure analysis, Soderberg and Goodman methods, estimation of life of a component, thermal stresses, creep                                                                                                                                                                                   |                   |
|           | <b>DESIGN OF MECHANICAL ELEMENTS</b>                                                                                                                                                                                                                                                                                                   | <b>(26 Hours)</b> |
|           | Design of welded, riveted and bolted joints, knuckle and cotter joints, threaded fasteners and power screws. Design of keys, splines, shafts and shaft couplings. Design of mechanical springs.                                                                                                                                        |                   |
|           | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                |                   |





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|----|---------------------------------------------------------------------------------------------------------------------|
| 3. | <b>Practical</b>                                                                                                    |
| 1  | Design and drawing of cotter joint                                                                                  |
| 2  | Design and drawing of knuckle joint                                                                                 |
| 3  | Design and drawing of any type of coupling:<br>a. Flange coupling<br>b. Rigid coupling<br>c. Bush-pin type coupling |
| 4  | Design and drawing of screw jack.                                                                                   |
| 5  | Design of spring                                                                                                    |
| 6  | Design of fasteners                                                                                                 |
| 7  | Design of levers                                                                                                    |
| 8  | Design of transmission shaft                                                                                        |

|    |                                                                                                                     |
|----|---------------------------------------------------------------------------------------------------------------------|
| 4. | <b>Books Recommended</b>                                                                                            |
| 1  | R. G. Budynas and K. Nisbett, Shigley's Mechanical Engineering Design, 11 <sup>th</sup> Edition, McGraw Hill, 2020. |
| 2  | R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, 6 <sup>th</sup> Edition, Wiley, 2017.   |
| 3  | V. B. Bhandari, Design of Machine Elements, 4 <sup>th</sup> Edition, Tata McGraw Hill, 2016.                        |
| 4  | R. L. Norton, Machine Design, 5 <sup>th</sup> Edition, Pearson Education India Ltd., 2014.                          |
| 5  | M. F. Spotts, Design of Machine Elements, Pearson Education India Ltd., 2004.                                       |



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|----------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>MECHANICS OF SOLIDS (INSTITUTE ELECTIVE-I)<br>ME351 | Scheme | L | T | P | Credit |
|                                                                                        |        | 3 | 0 | 0 | 03     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                                                                   |
|-----|---------------------------------------------------------------------------------------------------|
| CO1 | Analyse stress and strain.                                                                        |
| CO2 | Apply the basic methods to determine the deflection in beams                                      |
| CO3 | Design of columns under buckling                                                                  |
| CO4 | Compare the members under axis symmetric loads                                                    |
| CO5 | Examine the circular and non-circular cross section shafts under torsion loads and combined loads |
| CO6 | Illustrate the theoretical basis about the different strain energy methods                        |

|    |                                                                                                                                                                                                                                                                                                                                                                                                            |                   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                   |                   |
|    | <b>STRESS AND STRAIN ANALYSIS</b>                                                                                                                                                                                                                                                                                                                                                                          | <b>(08 Hours)</b> |
|    | Mohr's circle, principal stresses, principal planes, Analysis of Deformations: Small deformation theory, definition of strains, strain at a point, normal and shear strain, plane strain, strain transformations, Mohr's circle, principal strains, principal axes of strains, compatibility equations, strain gauge rosettes, strain displacement relations in cylindrical and spherical polar coordinate |                   |
|    | <b>DEFLECTION OF BEAM</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>(10 Hours)</b> |
|    | Equation of elastic curve for the loaded beam, relationship between bending moment, slope and deflection; calculation of deflection by integration, moment area and unit-load methods, Strain energy in flexure.                                                                                                                                                                                           |                   |
|    | <b>ELASTIC STABILITY OF COLUMNS</b>                                                                                                                                                                                                                                                                                                                                                                        | <b>(07 Hours)</b> |
|    | Euler's theory of initially straight columns, critical loads for different end condition of columns, eccentric loading, columns with small initial curvature, empirical formulae, Short struts subjected to eccentric loads                                                                                                                                                                                |                   |
|    | <b>MEMBERS SUBJECTED TO AXI-SYMMETRIC LOADS</b>                                                                                                                                                                                                                                                                                                                                                            | <b>(06 Hours)</b> |
|    | Stresses and strains in thin cylindrical shells and spheres under internal pressure, stresses in thin rotating rings.                                                                                                                                                                                                                                                                                      |                   |





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|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>TORSION OF NON- CIRCULAR SECTIONS</b>                                                                                                                                                                                                             | <b>(08 Hours)</b> |
|  | Torsion of shafts with rectangular cross-sections, wrapping, torsion of hollow shafts, torsion of thin tubes, shafts subjected to combined loads Torsion of shafts with arbitrary cross-sections, Prandtl stress function approach, membrane analogy |                   |
|  | <b>ENERGY METHODS</b>                                                                                                                                                                                                                                | <b>(06 Hours)</b> |
|  | Energy, reciprocal theorem, principle of virtual work, Castigliano's theorem, principle of minimum potential energy, Rayleigh-Ritz method for approximate solutions, principle of virtual work                                                       |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                              |                   |

|           |                                                                                                                         |
|-----------|-------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                |
| 1         | F. P. Beer, E. R. Johnston, Jr., J. T. Dewolf and D. E. Mazureu, Mechanics of Materials, 5th Edition, McGraw Hill, 2009 |
| 2         | S. P. Timoshenko and D. H. Young, Elements of Strength of Materials, 5th Edition, East West Press Pvt. Ltd., 2009       |
| 3         | S. Ramamurtham, Strength of Materials, Dhanpat Rai Publications, 2005                                                   |
| 4         | E. P. Popov, Engineering Mechanics of Solids, Prentice-Hall, 1999                                                       |
| 5         | L. S. Srinath, Advanced Mechanics of Solids, 3rd Edition, Tata McGraw Hill, 2009                                        |



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|------------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>SMART MATERIALS AND STRUCTURES<br>(INSTITUTE ELECTIVE-I)<br>ME353 | Scheme | L | T | P | Credit |
|                                                                                                      |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                         |
|-----|-----------------------------------------------------------------------------------------|
| CO1 | Understanding the basic principles of smart materials.                                  |
| CO2 | Explain various actuators and sensors in smart structures.                              |
| CO3 | Analyze smart composites.                                                               |
| CO4 | Illustrate the signal processing and control systems.                                   |
| CO5 | Describe the utilization of smart materials in engineering applications.                |
| CO6 | Apply fundamentals of smart materials and model the advanced structured smart material. |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                   |            |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                          |            |
|    | INTRODUCTION                                                                                                                                                                                                                                                                                                                                                                                                      | (12 Hours) |
|    | Introduction to smart materials and structures, Principles of piezoelectricity, Single crystals and Polycrystalline, Piezoelectric polymers, Magnetostrictive materials, Electro-active materials, Electronic materials, Electro-active polymers, Ionic polymer matrix composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rheological Fluids. |            |
|    | SENSING AND ACTUATION                                                                                                                                                                                                                                                                                                                                                                                             | (10 Hours) |
|    | Piezoelectric Sensors and actuators, Accelerometers, Active Fibre Sensing, Magnetostrictive Sensing, Shape Memory Actuators, Application of Smart Sensors and actuators for Structural Health Monitoring (SHM), Closed-loop and Open-loop Smart Structures, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control                                                   |            |
|    | SMART COMPOSITES                                                                                                                                                                                                                                                                                                                                                                                                  | (08 Hours) |
|    | Review of Composite Materials, Micro and Macro-mechanics, Modelling Laminated Composites based on Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, Governing Equation of Motion and Finite Element Modelling of Smart Composite Beams                                                                                                                             |            |
|    | SIGNAL PROCESSING AND CONTROL SYSTEMS                                                                                                                                                                                                                                                                                                                                                                             | (08 Hours) |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering

B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                      |                   |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System        |                   |
|  | <b>ADVANCES IN SMART STRUCTURES AND MATERIALS</b>                                                                                                                    | <b>(07 Hours)</b> |
|  | Self-sensing piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                              |                   |

|           |                                                                                                                 |
|-----------|-----------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                        |
| 1         | A.V. Srinivasan, Smart Structures –Analysis and Design, 1st Edition, Cambridge University Press, New York, 2001 |
| 2         | M. V. Gandhi and B. S. Thompson, Smart Materials and Structures, Chapman & Hall, London, 1992                   |
| 3         | C. Brian, Smart Structures and Materials, Artech House, 2000                                                    |
| 4         | P. Gauenzi, Smart Structures, Wiley, 2009                                                                       |
| 5         | W. G. Cady, Piezoelectricity, Dover Publication, New York, 2014                                                 |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                  |        |   |   |   |        |
|----------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>BIO-MECHANICS (INSTITUTE ELECTIVE-I)<br>ME355 | Scheme | L | T | P | Credit |
|                                                                                  |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                            |
|-----|----------------------------------------------------------------------------|
| CO1 | Illustrate general principles of biomechanics.                             |
| CO2 | Explain load on human body and applications of biomechanics.               |
| CO3 | Describe structure of human body.                                          |
| CO4 | Apply principles of kinetics and kinematics in motion of human body parts. |
| CO5 | Evaluate failure mechanisms of implants for joint replacements.            |
| CO6 | Analyze static and dynamic loads on biomaterials.                          |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |
|    | INTRODUCTION                                                                                                                                                                                                                                                                                                                                                                                                                                      | (06 Hours) |
|    | Introduction to Biomechanics, Standard reference terminology, Forms of motion, Joint movement terminology, Qualitative analysis of human movement. Tools for measuring kinematic quantities, Basic concepts related to kinetics, Mechanical load on human body, Tools for measuring kinetic quantities. Applications of Biomechanics.                                                                                                             |            |
|    | MUSCULOSKELETAL SYSTEM                                                                                                                                                                                                                                                                                                                                                                                                                            | (04 Hours) |
|    | Bone, Muscle, Ligament, Tendon, Cartilage and Meniscus – structure and function of anatomy of synovial joints – Hip, Knee, Shoulder, Elbow                                                                                                                                                                                                                                                                                                        |            |
|    | BIOMECHANICS OF HUMAN SKELETAL                                                                                                                                                                                                                                                                                                                                                                                                                    | (08 Hours) |
|    | Bone adaptation and Viscoelasticity, Bone anisotropy. Composition and structure of bone tissue, Bone growth and development, Bone response to stress, Osteoporosis, Joint architecture, Joint Stability, Technique for joint flexibility, Behavioral properties of musculotendinous unit, Structural organization of skeletal muscle, Skeletal muscle function, Factors affecting muscular force generation. Muscle strength, power and endurance |            |
|    | BIOMECHANICS OF HUMAN UPPER AND LOWER EXTREMITY                                                                                                                                                                                                                                                                                                                                                                                                   | (08 Hours) |
|    | Introduction, Structure of Shoulder, elbow, hip, ankle, foot, spine, wrist. Joints of the hand and knee, loads on Shoulder, elbow, hip, knee, Ankle, foot and spine. Movements of shoulder,                                                                                                                                                                                                                                                       |            |



**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

Department of Mechanical Engineering

B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | elbow, wrist, hand, hip, knee, ankle, foot and spine, Complex Loads on Shoulder, Muscles of spine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                   |
|  | <b>KINEMATICS AND KINETICS OF HUMAN BODY MOVEMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>(08 Hours)</b> |
|  | Introduction, Linear kinematic quantities, Kinematics of projectile motion. Factors influencing projectile trajectory, Analyzing projectile motion, Observing the angular kinematics of human movement. Measuring angles, Angular kinematics relationships, Relation between linear and angular motions, Mechanical behavior of bodies in contact. Resistance to angular acceleration, Angular momentum, Centripetal force. Joint Kinematics, Principle of Forward and Inverse Dynamics, Calculations on joint forces and moments, Calculations on muscle forces. Human movement in a fluid medium |                   |
|  | <b>BIOMECHANICS OF JOINT REPLACEMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>(05 Hours)</b> |
|  | Biomechanics of joint replacement – Hip, Knee, Shoulder, Spine, Cemented and Cementless fixation, Failure mechanisms of implants, Implant design considerations                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |
|  | <b>BIOMATERIALS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>(06 Hours)</b> |
|  | Introduction, Biological material, Man-made material, Current avenues of biomaterial research. Static load considerations. Cyclic loading consideration. Composite materials - the impetus for more flexible prostheses                                                                                                                                                                                                                                                                                                                                                                            |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |

|           |                                                                                                                            |
|-----------|----------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                   |
| 1         | S. A. Berger, W. Goldsmith and E. R. Lewis, Introduction to Bioengineering, Oxford University Press, 2023.                 |
| 2         | S. J. Hall, Basic Biomechanics, 8th edition, McGraw Hill, 2019.                                                            |
| 3         | D. Knudson, Fundamentals of Biomechanics, 3rd edition, Springer, 2021.                                                     |
| 4         | V C Mow & R Huiskes, Basic Orthopaedic Biomechanics and Mechano-biology, 3rd Edition, Lippincott Williams & Wilkins, 2005. |
| 5         | B. Nigg & W. Herzog. <i>Biomechanics of the Musculo-skeletal system</i> , 3rd edition, John Wiley & Sons, 2007.            |





**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

Department of Mechanical Engineering

B.Tech. –III, Mechanical Engineering (As per NEP)

| B.Tech. III (DoME) Semester – 5<br>COMPUTATIONAL FLUID DYNAMICS<br>(INSTITUTE ELECTIVE-I)<br>ME357 | Scheme | L | T | P | Credit |
|----------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
|                                                                                                    |        | 3 | 0 | 0 | 03     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                                                                               |
|-----|---------------------------------------------------------------------------------------------------------------|
| CO1 | Develop mathematical model for fluid flow and associated transport processes.                                 |
| CO2 | Classify various discretization methods and errors associated with numerical solution.                        |
| CO3 | Discretize the fundamental equations of flow and other transport processes using finite difference method.    |
| CO4 | Apply finite volume method for numerical modeling of fluid flow.                                              |
| CO5 | Solution of two-dimensional incompressible viscous flow problems using stream function vorticity formulation. |
| CO6 | Solve Navier-Stokes equations for incompressible flows using semi-explicit and semi-implicit algorithms.      |

|    |                                                                                                                                                                                                                                                                                                                                 |                   |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                 |                   |
|    | <b>GOVERNING EQUATIONS FOR FLUID FLOW AND HEAT TRANSFER</b>                                                                                                                                                                                                                                                                     | <b>(07 Hours)</b> |
|    | Conservation of Mass, Newton's Second Law of Motion, Expanded Forms of Navier Stokes equations, Conservation of Energy Principle, Special Forms of the Navier Stokes Equations, Classification of Second order Partial Differential Equations, Initial and Boundary Conditions, Governing Equations in Generalized Coordinates. |                   |
|    | <b>FINITE DIFFERENCE, DISCRETIZATION, CONSISTENCY, STABILITY</b>                                                                                                                                                                                                                                                                | <b>(08 Hours)</b> |
|    | Elementary Finite Difference Quotients, Basic Aspects of Finite Difference Equations, Error and Stability Analysis, Some Nontrivial Problems with Discretized Equations.                                                                                                                                                        |                   |
|    | <b>FINITE VOLUME METHOD FOR FLUID FLOW MODELING</b>                                                                                                                                                                                                                                                                             | <b>(12 Hours)</b> |
|    | Integral Approach, Discretization of Unsteady, Diffusion, Advection and Source Terms, Advection Schemes: Central Difference Scheme, First Order Upwind Scheme, Second Order Upwind Scheme, QUICK scheme and Other Higher Order Schemes, Finite Volume Solution of Unsteady Advection, Diffusion Problems with Source Term.      |                   |
|    | <b>SOLUTION OF VISCOUS INCOMPRESSIBLE FLOWS BY STREAM FUNCTION-VORTICITY FORMULATION</b>                                                                                                                                                                                                                                        | <b>(08 Hours)</b> |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

## Department of Mechanical Engineering B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                                                                                                                                                                                                                                                                                       |  |                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------|
| Two-Dimensional Incompressible Viscous Flow, Concept of stream-function and vorticity, Derivation of vorticity transport equation, Numerical solution of coupled equations for vorticity and stream function, Pressure Poisson equation, Application to flow over flat plate, flow through channel, lid driven cavity, flow over square cylinder etc. |  |                   |
| <b>SOLUTION OF NAVIER-STOKES EQUATIONS FOR INCOMPRESSIBLE FLOWS USING SEMI-EXPLICIT AND SEMI-IMPLICIT ALGORITHMS</b>                                                                                                                                                                                                                                  |  | <b>(10 Hours)</b> |
| Collocated and Staggered Grid, Solution of Unsteady Navier-Stokes Equations using Semi-explicit method for Collocated and Staggered grid, Momentum Interpolation, SIMPLE Algorithm, Formulation of Coupled Flow with Heat Transfer and other Scalar Transport.                                                                                        |  |                   |
| <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                               |  |                   |

|                             |                                                                                                                |
|-----------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>3. Books Recommended</b> |                                                                                                                |
| 1                           | D.A. Anderson, Tannehill J.C., Pletcher R.H., Computational Fluid Mechanics and Heat Transfer, CRC Press, 2012 |
| 2                           | K. Murlidhar, T. Sunderarajan, Computational Fluid Flow and Heat Transfer, Narosa Publisher, 2013              |
| 3                           | J.D. Anderson, Computational Fluid Dynamics, McGraw Hill, 2017                                                 |
| 4                           | S.V. Patankar, Numerical Heat Transfer and Flow, Hemisphre Publ. Corporation, 2017                             |
| 5                           | H.K. Versteeg, and W. Malasekara, An Introduction to Computational Fluid Dynamics, Pearson, 2008               |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                                                         |        |   |   |   |        |
|-------------------------------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>ELEMENTS OF MICRO HYDRO PLANT AND<br>PUMPING SYSTEMS (INSTITUTE ELECTIVE-I)<br>ME359 | Scheme | L | T | P | Credit |
|                                                                                                                         |        | 3 | 0 | 0 | 03     |

|                                                    |                                                                                                                                   |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <b>1. Course Outcomes (COs):</b>                   |                                                                                                                                   |
| At the end of the course, students will be able to |                                                                                                                                   |
| CO1                                                | Illustrate the concepts of hydro-electric power plant and classify different hydro-electric and micro hydro-electric power plant. |
| CO2                                                | Analyze flow prediction methods and evaluate flow transfer systems required based on site conditions.                             |
| CO3                                                | Identify different types of turbines and analyse their performance characteristics for selection in micro hydro plant.            |
| CO4                                                | Show the working of different types of governing, drives and electrical systems for micro hydro plants applications.              |
| CO5                                                | Explain the importance of suitable intake system for pumps.                                                                       |
| CO6                                                | Evaluate the performance of pump in piping system and understand various flow regulation methods for process control.             |

|           |                                                                                                                                                       |                   |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                       |                   |
|           | <b>INTRODUCTION</b>                                                                                                                                   | <b>(03 Hours)</b> |
|           | Classification of Hydro-Electric Power Plant, Micro hydro power plant: overview and components.                                                       |                   |
|           | <b>HYDROLOGY, SITE SURVEY AND CIVIL WORKS</b>                                                                                                         | <b>(12 Hours)</b> |
|           | Introduction, flow prediction, head measurements, site measurements of flow, civil works, system layout, Weir, spillways, channel, penstocks.         |                   |
|           | <b>TYPES OF TURBINES</b>                                                                                                                              | <b>(07 Hours)</b> |
|           | Impulse, Turgo, Cross flow, Reaction, Reverse pump, hydrokinetic turbines, selection of turbine.                                                      |                   |
|           | <b>GOVERNING, DRIVE AND ELECTRICAL POWER SYSTEM</b>                                                                                                   | <b>(06 Hours)</b> |
|           | Purpose of governing, approaches to the governing, Direct couple drives: components, basic electricity, choosing supply, generators, synchronization. |                   |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                  |                   |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>PUMP INTAKE SYSTEM</b>                                                                                                                                                        | <b>(05 Hours)</b> |
|  | Suction Tank, sump and suction pipe, common faults, air entrainments, foam formation, turbulence, suitable connections, valves, and arrangements of suction pipe and reservoirs. |                   |
|  | <b>INTEGRATION OF PUMPS AND PIPING SYSTEM</b>                                                                                                                                    | <b>(08 Hours)</b> |
|  | Pump operating point and range of operation, system curve, single and branch pipe system, variable system curves, multiple pump systems, water hammer and protection.            |                   |
|  | <b>CAPACITY REGULATION OF PUMP IN PIPING SYSTEM</b>                                                                                                                              | <b>(04 Hours)</b> |
|  | Throttle regulation, regulation with bypass, speed regulation and proportional pressure control, constant pressure control, and constant temperature control.                    |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                          |                   |

|           |                                                                                                                              |
|-----------|------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                     |
| 1         | Designing and Building Mini and Micro Hydro Power Schemes, Luis Rodríguez, Practical Action Publishing, 2011                 |
| 2         | Rotodynamic Pumps (Centrifugal and Axial), K. Srinivasan, Springer, 2024                                                     |
| 3         | Pump Handbook, Igor J. Karassik et al., McGraw Hill, 2007                                                                    |
| 4         | Rotodynamic and Positive Displacement Types: Theory, Design and Applications, Sahu GK. Pumps, New Age International; 2017    |
| 5         | Planning and Installing Micro-Hydro Systems: A Guide for Designers, Installers and Engineers, Chris Elliott, Routledge, 2014 |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                     |        |   |   |   |        |
|-------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>RENEWABLE ENERGY (INSTITUTE ELECTIVE-I)<br>ME361 | Scheme | L | T | P | Credit |
|                                                                                     |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                   |
|-----|-------------------------------------------------------------------------------------------------------------------|
| CO1 | Understand sun-earth orientation and calculate incidence angle of solar radiation                                 |
| CO2 | Design solar systems for a given energy utility by applying principles of solar energy conversion                 |
| CO3 | Estimate the wind potential and perform power forecast analysis                                                   |
| CO4 | Develop bio-energy based systems for a given utility by applying principles of bio-mass to bio-energy conversion. |
| CO5 | Characterize different types of waste and compare various conversion technologies.                                |
| CO6 | Compare Hydrogen with other energy resources in present context                                                   |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |
|    | <b>SOLAR ENERGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>(14 hours)</b> |
|    | Extra-terrestrial and terrestrial, Solar radiation measuring instruments, Estimation of Solar Radiation, Various earth-sun angles. Solar Thermal Systems: Flat plate collectors, working of flat plate collectors, selective coating, working principle of evacuated tube collector, solar water heater, solar air heater, Parabolic trough collector, tracking mechanism, cosine losses, Parabolic dish collector, Linear Fresnel reflector, Heliostat field collector, Scheffler reflector, Applications of solar collectors, Solar photovoltaic systems: Principle of photovoltaic conversion of solar energy, Solar cells, Materials of solar cells, PV cell characteristics, Solar energy storage options: Electrical and heat storage technologies |                   |
|    | <b>BIO-MASS &amp; BIO-ENERGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>(12 hours)</b> |
|    | Biogas System: Anaerobic digestion, biogas production, Types of digesters, installation, operation and maintenance of biogas plants, Biogas plant manure utilisation and manure values, factors affecting biogas production, Biogas utilisation and storage, biogas for motive power generation, design calculations for biogas plants, Govt. policies. Liquid Biofuels: Biodiesel – The mechanism of transesterification, fuel characteristics of biodiesel, technical aspects of biodiesel/Ethanol and other liquid fuels utilization in engine. Biomass gasification: Different types, power generation                                                                                                                                               |                   |
|    | <b>WASTE TO ENERGY CONVERSION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>(06 hours)</b> |



**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

Department of Mechanical Engineering

B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                                                                                                                                                                            |                   |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Introducing municipal solid waste management; Waste generation and characterization, Waste processing techniques; Source reduction, biological conversion products: Compost and biogas, Incineration pyrolysis and energy recovery, waste plastic, RDF utilization, Govt. Policies                                                         |                   |
|  | <b>WIND ENERGY</b>                                                                                                                                                                                                                                                                                                                         | <b>(08 hours)</b> |
|  | History of wind energy, Current status and future prospects, Wind energy in India. Power available in the wind, Components of Wind Energy Conversion Systems, Horizontal and Vertical axis wind turbine, Wind turbine power and torque characteristics, Tip speed ratio, Wind speed prediction and forecasting, Betz limit, Govt. Policies |                   |
|  | <b>HYDROGEN ENERGY AND FUEL CELLS</b>                                                                                                                                                                                                                                                                                                      | <b>(05 hours)</b> |
|  | Benefits of Hydrogen Energy, Hydrogen production technologies, Hydrogen energy storage, Use of hydrogen energy, advantages and disadvantages of Hydrogen Energy, Problems associated with hydrogen energy, Basic principle of working of fuel cell.                                                                                        |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                    |                   |

|           |                                                                                                    |
|-----------|----------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                           |
| 1         | J. A. Duffie and W.A. Beckman, Solar Engineering and Thermal Processes, John Wiley and Sons., 2013 |
| 2         | G. N. Tiwari, Solar Energy, Narosa Publishing House Pvt. Ltd., 2012                                |
| 3         | H. S. Mukunda, Understanding Clean Energy and fuels from biomass. Wiley India Pvt. Ltd, 2011       |
| 4         | K. M. Mital, Biogas Systems, Principle and Applications. New Age International Ltd, 1996           |
| 5         | G. D. Rai, Non-Conventional Energy Sources, Khanna Publication, 1988                               |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering

B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                           |        |   |   |   |        |
|-------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>Additive Manufacturing (INSTITUTE ELECTIVE-I)<br>ME363 | Scheme | L | T | P | Credit |
|                                                                                           |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                         |
|-----|-------------------------------------------------------------------------------------------------------------------------|
| CO1 | Compare and distinguish various additive manufacturing processes.                                                       |
| CO2 | Explain the process chain for selected additive manufacturing process.                                                  |
| CO3 | Decide and recommend suitable additive manufacturing process for a given material and application.                      |
| CO4 | Identify defects in model and reframe in standard format.                                                               |
| CO5 | Analyze the key drivers of additive manufacturing.                                                                      |
| CO6 | Integrate design concepts with CAD or reverse engineering for geometry preparation for additive manufacturing of parts. |

|    |                                                                                                                                                                                                                                   |            |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                          |            |
|    | INTRODUCTION                                                                                                                                                                                                                      | (07 Hours) |
|    | Definition, classification, stages of generic additive manufacturing process, benefits, applications, process selection, evaluation, benchmarking, future growth and opportunities                                                |            |
|    | LIQUID BASED PROCESSES                                                                                                                                                                                                            | (09 Hours) |
|    | Photo polymerization, principle and working of stereo lithography apparatus, scanning techniques, curing processes, typical materials and applications.                                                                           |            |
|    | POWDER BASED PROCESSES                                                                                                                                                                                                            | (09 Hours) |
|    | Powder fusion mechanism, powder handling and recycling, Principle and working of Selective Laser Sintering, Laser Engineering Net Shaping process, Electron Beam Melting, process parameters, typical materials and applications. |            |
|    | SOLID BASED PROCESSES                                                                                                                                                                                                             | (08 Hours) |
|    | Basic principle and working of fused deposition modelling process, liquification, solidification and bonding, bio extrusion, Laminated Object Manufacturing process, Multi jet process, typical materials and applications.       |            |
|    | SOFTWARE ISSUES IN ADDITIVE MANUFACTURING                                                                                                                                                                                         | (06 Hours) |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering

B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                             |                   |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Preparation of CAD models and STL files, STL file problems and repair, slicing, newly proposed formats, standards, softwares to assist additive manufacturing, role of reverse engineering. |                   |
|  | <b>DESIGN FOR ADDITIVE MANUFACTURING</b>                                                                                                                                                    | <b>(06 Hours)</b> |
|  | Core concepts and objectives, unique capabilities of Additive Manufacturing, exploring design freedom, design tools.                                                                        |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                     |                   |

|           |                                                                                                                          |
|-----------|--------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                 |
| 1         | Gibson, D. Rosen, B. Stucker, Additive Manufacturing Technologies, Springer Publisher, 2010                              |
| 2         | C. K. Chua, K. F. Leong, C. S. Lim, Rapid Prototyping – Principles and Applications, World Scientific, 3rd Edition, 2010 |
| 3         | R. Noorani, 3D printing technology, applications and selection, CRC Press, 2017                                          |
| 4         | M. W. M. Cunico, 3D Printers and Additive Manufacturing: the rise of the industry 4.0, Concept 3D, 2019                  |
| 5         | A. Bandyopadhyay and S. Bose, Additive Manufacturing, CRC Press, 2015                                                    |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                                    |        |   |   |   |        |
|----------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>POWDER PROCESSING TECHNIQUES<br>(INSTITUTE ELECTIVE-I)<br>ME365 | Scheme | L | T | P | Credit |
|                                                                                                    |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                                                      |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Demonstrate the importance of powder processing route of manufacturing process, and compare powder metallurgy products with cast & wrought products. |
| CO2 | Compare different techniques of production, testing and characterization of ceramic and metal powders.                                               |
| CO3 | Explain different methods of conditioning of powders and analyze various techniques of compactions of powder products.                               |
| CO4 | Show mechanism of sintering of green powder compacts and secondary & finishing operations in powder processing.                                      |
| CO5 | Analyze significance of sintering and secondary operations.                                                                                          |
| CO6 | Explain detailed procedure of manufacturing of selected products by powder processing.                                                               |

|    |                                                                                                                                                                                                                                                                                                                                   |            |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                          |            |
|    | INTRODUCTION                                                                                                                                                                                                                                                                                                                      | (06 Hours) |
|    | History, Basic terms related to powder processing, principle and outline of powder processing techniques, advantages and limitations of powder processing, General characteristics of ceramic and metal powders. Comparison of powder processed parts with cast and wrought products, Design considerations in powder metallurgy. |            |
|    | PRODUCTION OF POWDERS                                                                                                                                                                                                                                                                                                             | (06 Hours) |
|    | Atomization, variants of atomization, Chemical reduction, Carbonyls, Electrolytic deposition, Mechanical pulverization methods - crushing, milling etc.; vapour condensation, precipitation from chemical solution, high temperature extractive metallurgy processes, production of nano powders, Microencapsulated powders.      |            |
|    | TESTING & CHARACTERIZATION OF POWDERS                                                                                                                                                                                                                                                                                             | (07 Hours) |
|    | Physical characterization related to powder particles - shapes, size, mesh number, size distribution, surface area, porosity; flow rate, tap density, apparent density, true density, compressibility and friction; chemical characterization related to chemical compositions, phase composition and surface characterization.   |            |





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|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>POWDER CONDITIONING AND HEAT TREATMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>(03 Hours)</b> |
|  | Alloying, sintering aids, lubricants, plasticizers and binders, mixing and blending, granulation; Equipment for powder conditioning, Heat treatments of powders.                                                                                                                                                                                                                                                                                                                             |                   |
|  | <b>COMPACTION OF POWDER PRODUCTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>(08 Hours)</b> |
|  | Conventional die pressing, pressure distribution during conventional die pressing, cold iso-static pressing, powder rolling, powder extrusion, injection moulding, hot iso-static pressing, spray deposition (Osprey process), pressure less compaction, compaction using ceramic moulds.                                                                                                                                                                                                    |                   |
|  | <b>SINTERING &amp; SECONDARY OPERATIONS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>(11 Hours)</b> |
|  | Defects and defect chemistry; Solid state sintering, atomic mechanisms, coarsening, densification, sintering kinetics: sintering stages, coarsening and grain growth kinetics; Liquid phase sintering: introduction, the different stages, controlling kinetics and thermodynamic factors; Sintering furnaces and their classifications, batch furnace, continuous furnaces, sintering atmosphere, vacuum sintering. Finishing, machining, infiltration, Repressing, Resizing, Impregnation. |                   |
|  | <b>SELECTED POWDER PRODUCTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>(04 Hours)</b> |
|  | Sintered carbides and carbide tools; Cermets; Dispersion strengthened materials; Automotive-engine bearing cap, Electrical contact materials; Self-lubricating bearings & gears, Filters, Friction materials.                                                                                                                                                                                                                                                                                |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |

|           |                                                                                                                                |
|-----------|--------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                       |
| 1         | R. M. German, Powder Metallurgy and Particulate Materials Processing, MPIF, 2005                                               |
| 2         | K. Hingashitani, H. Makino, S. Matsusaka, Powder Technology Handbook, CRC Press, 2019                                          |
| 3         | A. Upadhyaya, G. S. Upadhyaya, Powder Metallurgy - Science, Technology & Materials, Universities Press, Taylor & Francis, 2018 |
| 4         | P. C. Angelo, R. Subramanian, Powder metallurgy - Science, Technology and Applications, PHI Learning Pvt. Ltd., 2008           |
| 5         | B. K. Datta, Powder Metallurgy: An Advanced Technique of Processing Engineering Materials, 2014                                |



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|                                                                                                     |        |   |   |   |        |
|-----------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>PRODUCTION PLANNING & CONTROL<br>(INSTITUTE ELECTIVE-I)<br>ME367 | Scheme | L | T | P | Credit |
|                                                                                                     |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                         |
|-----|-------------------------------------------------------------------------|
| CO1 | Describe the concept of production planning and control act work study. |
| CO2 | Importance of the concept of product planning.                          |
| CO3 | Analyze the production scheduling.                                      |
| CO4 | Apply the Inventory Control concepts.                                   |
| CO5 | Develop the manufacturing requirement Planning (MRP II).                |
| CO6 | Create the enterprise Resource Planning (ERP).                          |

|    |                                                                                                                                                                                                                                                                                                                                                                                                            |            |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                   |            |
|    | INTRODUCTION                                                                                                                                                                                                                                                                                                                                                                                               | (09 hours) |
|    | Objectives and benefits of planning and control; Functions of production control; Types of production: job, batch and continuous; Product development and design; Marketing aspect; Functional aspects; Operational aspect; Durability and dependability aspect; aesthetic aspect. Profit consideration; Standardization, Simplification & specialization; Break even analysis; Economics of a new design. |            |
|    | WORK STUDY                                                                                                                                                                                                                                                                                                                                                                                                 | (09 hours) |
|    | Method study, basic procedure; Selection; Recording of process; Critical analysis, Development; Implementation; Micro motion and memo motion study; Work measurement; Techniques of work measurement; Time study; Production study; Work sampling; Synthesis from standard data; Predetermined motion time standards.                                                                                      |            |
|    | PRODUCT PLANNING AND PROCESS PLANNING                                                                                                                                                                                                                                                                                                                                                                      | (09 hours) |
|    | Product planning; Extending the original product information; Value analysis; Problems in lack of product planning; Process planning and routing; Pre requisite information needed for process planning; Steps in process planning; Quantity determination in batch production; Machine capacity, balancing; Analysis of process capabilities in a multi-product system.                                   |            |





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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>PRODUCTION SCHEDULING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>(09 hours)</b> |
| Production Control Systems; Loading and scheduling; Master Scheduling; Scheduling rules; Gantt charts; Perpetual loading; Basic scheduling problems; Line of balance; Flow production scheduling; Batch production scheduling; Product sequencing; Production Control systems; Periodic batch control; Material requirement planning; Kanban; Dispatching; Progress reporting and expediting; Manufacturing lead time; Techniques for aligning completion times and due dates. |                   |
| <b>INVENTORY CONTROL AND RECENT TRENDS IN PPC</b>                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>(09 hours)</b> |
| Inventory control; Purpose of holding stock; Effect of demand on inventories; Ordering procedures. Two bin system; Ordering cycle system; Determination of Economic order quantity and economic lot size; ABC analysis; Recorder procedure; Introduction to computer integrated production planning systems; Elements of JUST IN TIME SYSTEMS; Fundamentals of MRP II and ERP.                                                                                                 |                   |
| <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |

|                                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>3. Books Recommended</b>                                                                                                          |
| 1 Elwood S. Buffa, and Rakesh K. Sarin, Modern Production / Operations Management, 8 <sup>th</sup> Edition John Wiley and Sons, 2000 |
| 2 Kanishka Bedi, Production and Operations management, 2 <sup>nd</sup> Edition, Oxford university press, 2007                        |
| 3 Norman Gaither, G. Frazier, Operations Management, 9 <sup>th</sup> Edition, Thomson learning IE, 2007                              |
| 4 Upendra Kachru, Production and Operations Management – Text and cases, 1 <sup>st</sup> Edition, Excel books, 2007                  |
| 5 Martand Telsang, Industrial Engineering and Production Management, 1 <sup>st</sup> Edition, S. Chand and Company, 2000             |





|                                                                                          |        |   |   |   |        |
|------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>ANALYSIS AND SYNTHESIS OF MECHANICS (HONORS)<br>MEHD2 | Scheme | L | T | P | Credit |
|                                                                                          |        | 3 | 1 | 0 | 04     |

**1. Course Outcomes (COs):**

**At the end of the course, students will be able to**

|     |                                                                                               |
|-----|-----------------------------------------------------------------------------------------------|
| CO1 | Illustrate the fundamentals of kinematics of different mechanisms.                            |
| CO2 | Analyze the kinematics of planar and spatial mechanisms containing different number of links. |
| CO3 | Apply the principles of path curvature theory to design different mechanisms.                 |
| CO4 | Synthesize and evaluate different mechanisms using graphical and analytical methods.          |
| CO5 | Examine the dynamics of different mechanisms and use simulation software packages.            |
| CO6 | Understand the different softwares for dynamic analysis.                                      |

|           |                                                                                                                                                                                                                                                                                                                                                                              |                   |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                              |                   |
|           | <b>INTRODUCTION</b>                                                                                                                                                                                                                                                                                                                                                          | <b>(08 Hours)</b> |
|           | Review of fundamentals of kinematics; Classifications of mechanisms; Components of mechanisms; Mobility analysis; Formation of one degree-of-freedom (DOF) multi-loop kinematic chains; multi-DOF planar linkages; Network formula; Gross motion concepts; Basic kinematic structures of serial and parallel robot manipulators; Compliant mechanisms; Equivalent mechanisms |                   |
|           | <b>KINEMATIC ANALYSIS OF MECHANISMS</b>                                                                                                                                                                                                                                                                                                                                      | <b>(08 Hours)</b> |
|           | Position Analysis; Vector loop equations for four bar, slider-crank, inverted slider-crank, geared five bar, and six bar linkages; Analytical methods for velocity and acceleration analysis of simple mechanisms; Analysis of planar complex mechanisms; Spatial RSSR mechanisms; D-H parameters; Forward and inverse kinematics of robot manipulators                      |                   |
|           | <b>PATH CURVATURE THEORY</b>                                                                                                                                                                                                                                                                                                                                                 | <b>(07 Hours)</b> |
|           | Fixed and moving centrodes; Inflection points and inflection circle; Euler-Savary equation; Graphical constructions – cubic of stationary curvature; Four bar coupler point curves; Cusp-crunode-coupler driven six-bar mechanisms                                                                                                                                           |                   |



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|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>SYNTHESIS OF MECHANISMS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>(15 Hours)</b> |
|  | Type synthesis; Number synthesis; Associated linkage concept; Dimensional synthesis; Function generation; Path generation; Motion generation; Graphical methods; Pole technique; Inversion technique; 2-, 3-, and 4- position synthesis of four bar mechanisms; Analytical methods- Freudenstein's equation; Cognate linkages; Parallel motion linkages; Design of six bar mechanisms with single and multi-dwells; Geared five bar mechanism with multi-dwell; Determination of optimum size of cams. |                   |
|  | <b>DYNAMICS OF MECHANISMS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>(07 Hours)</b> |
|  | Combined static and inertia force analysis; Kinetostatic analysis of planar mechanisms; Force and moment balancing of linkages; Study of different mechanism simulation software packages                                                                                                                                                                                                                                                                                                              |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                   |

|                     |                                                                                |
|---------------------|--------------------------------------------------------------------------------|
| <b>3. Tutorials</b> |                                                                                |
| 1                   | Mobility analysis                                                              |
| 2                   | Formation of multi-DOF planar linkages                                         |
| 3                   | Kinematic structures of serial and parallel robot manipulators                 |
| 4                   | Compliant mechanisms                                                           |
| 5                   | Analytical methods for velocity and acceleration analysis of planar mechanisms |
| 6                   | Analysis of planar complex mechanisms                                          |
| 7                   | Forward and inverse kinematics of robot manipulators                           |
| 8                   | Graphical construction – four bar coupler point curves                         |
| 9                   | Graphical construction – cubic of stationary curvature                         |
| 10                  | Graphical methods of synthesis of mechanisms                                   |
| 11                  | Analytical methods of synthesis of mechanisms                                  |
| 12                  | Combined static and inertia force analysis                                     |

|                             |                                                                                                                                                   |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4. Books Recommended</b> |                                                                                                                                                   |
| 1                           | K. J. Waldron, G. L. Kinzel, and S. K. Agrawal. Kinematics, Dynamics and Design of Machinery, 3 <sup>rd</sup> Edition, John Wiley, 2016           |
| 2                           | J. J. Uicker, G. R. Pennock, and J. E. Shigley. Theory of Machines and Mechanisms, 4 <sup>th</sup> Edition, Oxford University Press, London, 2014 |
| 3                           | D. H. Myszka. Machines and Mechanisms: Applied Kinematic Analysis, 4 <sup>th</sup> Edition, Pearson Education India, New Delhi, 2015              |
| 4                           | A. Ghosh and A. K. Mallik. Theory of Mechanisms and Machines, Affiliated East West Press, New Delhi, 2008                                         |
| 5                           | E. Constandas and K. B. Dyer. Introduction to Mechanism Design with Computer Applications, 1 <sup>st</sup> Edition, CRC Press, Boca Raton, 2019   |





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|-----------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>ADVANCED HEAT TRANSFER (HONORS)<br>MEHT2 | Scheme | L | T | P | Credit |
|                                                                             |        | 3 | 1 | 0 | 04     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                          |
|-----|--------------------------------------------------------------------------|
| CO1 | Model heat transport phenomena in Cartesian and Cylindrical domain       |
| CO2 | Plan analytical solutions for hat conduction with heat generation        |
| CO3 | Elaborate the concept of bulk radiation and radiative transport equation |
| CO4 | Analyse flows with free for forced convective heat transfer              |
| CO5 | Develop analogy between momentum and heat transfer                       |
| CO6 | Comprehend the concepts of boiling and condensation                      |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |
|    | <b>CONDUCTION HEAT TRANSPORT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>(10 Hours)</b> |
|    | Control volume approach, constitutive relations, Energy equation in terms of temperature, Implication of Fourier's law: principles of local action and determinism, Tensor and scalar conductivities, second law analysis of Fourier's law of heat conduction, Expanded form of heat conduction equation in various coordinate systems. Non-dimensional form and dimensionless parameters, Initial and boundary conditions: Dirichlet, Neumann and Robin boundary conditions, radiation BC, treatment of interfaces. |                   |
|    | <b>ANALYTICAL SOLUTION OF THE HEAT CONDUCTION EQUATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>(07 Hours)</b> |
|    | Analytical solution of the steady heat conduction equation: two dimensional regions (Cartesian and cylindrical), Separation of Variables approach, Steady and unsteady heat conduction in a slab of finite thickness; effect of heat generation; non-zero initial condition; constant flux and convective boundary conditions, Analytical solution of the unsteady heat conduction equation, Solution by similarity variables and Laplace transforms.                                                                |                   |
|    | <b>RADIATION HEAT TRANSPORT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>(10 Hours)</b> |
|    | Radiation Heat Exchange between surfaces —Gas Radiation —Equivalent beam length, Enclosure theory in the presence of a radiating gas, Radiative Transfer Equation, General and Exact solution of RTE, Isothermal gas enclosures, Well-stirred furnace model, Gas radiation in complex enclosures, Interaction between radiation and other modes of heat transfer.                                                                                                                                                    |                   |





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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>CONVECTIVE HEAT TRANSFER</b>                                                                                                                                                                                                                                                                                                               | <b>(10 Hours)</b> |
| Free and Forced convection; Similarity and Simulation of convection heat transfer, use of Boundary layer theory; Laminar internal and external flow heat transfer, Turbulent flow heat transfer; Analogy between momentum and heat transfer. Heat transfer in high velocity flow; Natural convection under different Engineering applications |                   |
| <b>CONVECTIVE HEAT TRANSFER WITH PHASE CHANGE</b>                                                                                                                                                                                                                                                                                             | <b>(08 Hours)</b> |
| Condensation: Laminar film on a vertical surface, turbulent film on a vertical surface, Film condensation in other configurations, dropwise condensation, effect of non-condensable gases in condensing equipment's; Boiling: Pool boiling regimes, Nucleate boiling and peak heat flux, Film boiling and minimum heat flux, Flow boiling     |                   |
| <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                       |                   |

|                             |                                                                                                    |
|-----------------------------|----------------------------------------------------------------------------------------------------|
| <b>3. Books Recommended</b> |                                                                                                    |
| 1                           | Muralidhar K and Banerjee Jyotirmay, Conduction and Radiation, Narosa Publication New Delhi, 2010. |
| 2                           | Incropera and Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, USA, 2011.               |
| 3                           | Greg F. Naterer, Advanced Heat Transfer, 3rd Edition, CRC Press, 2021                              |
| 4                           | Amir Faghri, Yuwen Zhang, John Howell, Advanced Heat and Mass Transfer, Global Digital Press, 2010 |
| 5                           | Biswas G, Dalal Amaresh, Dhir V K, Fundamentals of Convective Heat Transfer, CRC Press, 2019.      |



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|-------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>INDUSTRY 5.0 (HONORS)<br>MEHM2 | Scheme | L | T | P | Credit |
|                                                                   |        | 3 | 1 | 0 | 04     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                       |
|-----|---------------------------------------------------------------------------------------|
| CO1 | Explain the important technological innovations of industrial revolutions 1.0 to 4.0. |
| CO2 | Outline the characteristics, essence, and added features of Industry 4.0              |
| CO3 | Show the characteristics, essence, and added features of Industry 5.0                 |
| CO4 | Apply the enabling technologies of Industry 5.0                                       |
| CO5 | Analyse the challenges of Industry 5.0                                                |
| CO6 | Illustrate the applications of Industry 5.0                                           |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
|    | <b>TECHNOLOGICAL INNOVATIONS OF INDUSTRIAL REVOLUTIONS 1.0 TO 4.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>(08 Hours)</b> |
|    | First and second industrial revolutions; Third industrial revolution, programmable logic controllers, SCADA, industrial robots; Fourth industrial revolution, internet of things (IoT), industrial internet of things (IIoT), 3D printing, virtual reality (VR), augmented reality (AR), big data analytics, simulation; Review of existing maturity models for Industry 4.0                                                                                                                                                                                                                                                            |                   |
|    | <b>CHARACTERISTICS, ESSENCE, AND ADDED FEATURES OF INDUSTRY 5.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>(12 Hours)</b> |
|    | Motivations behind the evolution of Industry 5.0; Definition of Industry 5.0; Characteristics of Industry 5.0, human centricity, sustainability, resilience; Essence of Industry 5.0, collaborative intelligence, multi-objective interweaving, multi-technology restructuring, multi-discipline integration, multi-sector symbiosis, multi-systems heterogeneity; Added features of Industry 5.0: smart additive manufacturing, predictive maintenance, hyper customization, cyber-physical cognitive systems, waste management through industrial upcycling, collaborative robots, artificial intelligence; Benefits of industry 5.0. |                   |
|    | <b>ENABLING TECHNOLOGIES AND CHALLENGES OF INDUSTRY 5.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>(16 Hours)</b> |
|    | Cloud computing; Edge computing; Digital twins and metaverse; Collaborative robots (Cobots); Internet of everything (IoE); Blockchain and decentralized computing; 6G and beyond; Network slicing (NS); Extended reality (XR) and holography; Private mobile network (PMN); Advanced sensors; Drones; Machine-to-machine interaction; Ergonomics and bionics; Human-centric AI architecture, mutual-cognitive human-robot collaboration in factory, skilled                                                                                                                                                                             |                   |





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|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
|  | workforce, cognitive computing skills with human intelligence and resourcefulness; Implementation challenges and limitations of Industry 5.0, social barriers, transformation challenges, technological challenges, challenges related to data storage, security, and privacy, additive manufacturing scalability, chaos in human-robot collaboration, and regulatory compliance |                                         |
|  | <b>APPLICATIONS OF INDUSTRY 5.0</b>                                                                                                                                                                                                                                                                                                                                              | <b>(09 Hours)</b>                       |
|  | Automotive sector; Hi-tech electronics industrial sector; Processing and industrial manufacturing sectors; Energy sector; Education sector; Supply chain management, Intelligent healthcare, Disaster management; Future directions of Industry 5.0                                                                                                                              |                                         |
|  |                                                                                                                                                                                                                                                                                                                                                                                  | <b>(Total Contact Time: = 45 Hours)</b> |

|           |                                                                                                                                                 |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                        |
| 1         | U. Elangovan. Industry 5.0: The Future of the Industrial Economy, CRC Press, Boca Raton, 2022.                                                  |
| 2         | M. N. Bakkar and E. McKay. Advanced Research and Real-World Applications of Industry 5.0, IGI Global, Pennsylvania, 2023.                       |
| 3         | P. Sharma, India Automated: How the Fourth Industrial Revolution is Transforming India. Macmillan, Mumbai, 2019.                                |
| 4         | K. Kotecha, S. Kumar, A. Bongale, and R. Suresh. Industry 4.0 in Small and Medium-Sized Enterprises (SMEs), CRC Press, Boca Raton, 2022.        |
| 5         | H. Allam, H. Arezou, B. Ameena, A. Pallavi, and A. Hala. From Industry 4.0 to Industry 5.0: Mapping the Transitions, Springer, Singapore, 2023. |



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|------------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>ELECTRIC VEHICLES AND ENERGY STORAGE<br>SYSTEMS (HONORS)<br>MEHE2 | Scheme | L | T | P | Credit |
|                                                                                                      |        | 3 | 1 | 0 | 04     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                                                       |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Get acquainted with the types of EVs, their comparison with ICE Vehicles and general aspects of major components of EV including architecture design. |
| CO2 | Apply basic know how of electric, electronic and battery fundamentals to solve related problems linked with EV.                                       |
| CO3 | Evaluate performance of Li Ion batteries and work out problems pertaining to various aspects of EV Batteries.                                         |
| CO4 | Explain the performance of electric motors, control units, BMS systems and calculate the sizing requirement.                                          |
| CO5 | Show the mechanical aspects and EV charging related aspects of EV.                                                                                    |
| CO6 | Work out prospects of EVs taking into account economics, various Policies safety aspects of EVs.                                                      |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |
|    | <b>INTRODUCTION TO ELECTRIC VEHICLES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>(08 Hours)</b> |
|    | Historical Developments in Hybrid Electric Vehicles and Electric Vehicles. Prospects and Challenges of EVs, Comparison of EVs with I C Engines vehicles, Advantages and disadvantages of electric vehicles, Major components of Electric Vehicles. Types of Electric Vehicle and components, Electric Vehicle Architecture Design, Electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV. |                   |
|    | <b>EV POWER TRAIN</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>(08 Hours)</b> |
|    | Basic components like Battery, DC-AC Converters, Electric Motors, DC-DC Converters, Transmissions and ECUs. Battery and Motor Selection, Calculations for Motor and battery sizing for EV for Two, Three and Four Wheeler Applications, Thermal Management of Battery, Initial acceleration, rated vehicle velocity, maximum velocity and maximum gradeability of EV, Basic architecture of EV Drive Train                                                                                                                                                                         |                   |





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|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>BATTERY FUNDAMENTALS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>(08 Hours)</b> |
|  | Dry Cell, Wet Cell, Vehicle Batteries, Functions of Batteries, Construction of Lead Acid Battery, Battery Grids, Electrolyte, Container, Cell Cover, Vent Plug, Cell and Battery Arrangement, Electrochemical Action, Charging and Discharging, Basics of Alkaline Battery, Nickel Cadmium Battery, Nickel Metal Hydride Battery, Sodium Sulphur Battery, Aluminium Air Battery, Battery selection criteria. Jump starting, Boost charging, Maintenance Free Battery, Good practices for battery extended life.                                                                                                                               |                   |
|  | <b>LITHIUM-ION BATTERY FOR EV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>(08 Hours)</b> |
|  | Why Li-Ion Battery, Advantages over other conventional Batteries, Charging and Discharging reactions, Battery Performance Assessment, Battery Characteristics, Battery Terminology - Battery Ratings and Capacity, Cyclic Life, Thermal Run Away, Battery Efficiency, Battery Testing, Battery charging and discharging calculation, Cell Selection and sizing, Battery layout design, Battery Pack Configuration, Battery Pack material and design consideration, Construction, Battery Pack Sizing, Thermal Design of Battery Pack, Heat Load Determination and Thermal Management of Battery. Alternative energy storage devices           |                   |
|  | <b>EV CHARGING TECHNOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>(08 Hours)</b> |
|  | Classification of different charging technology for EV charging station, introduction to Grid-to-Vehicle, Vehicle to Grid (V2G) or Vehicle to Buildings (V2B) or Vehicle to Home (V2H) operations, bi-directional EV charging systems, energy management strategies used in hybrid and electric vehicle, Wireless power transfer (WPT) technique for EV charging, Type of Charging station, Selection and Sizing of charging station, Components of charging station, Single line diagram of charging station, Charging and Energy Infrastructure Planning, Depot Infrastructure and Equipment Planning, Charging and Swapping Infrastructure |                   |
|  | <b>MECHANICAL ASPECTS OF EV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>(05 Hours)</b> |
|  | Calculating the Rolling Resistance, calculating the grade resistance, Calculating the Acceleration Force, Finding The Total Tractive Effort, Torque Required on the Drive Wheel, Drive Cycle and Energy requirement per km calculations, Chassis and body considerations for EV and HEV, Steering System for EV and HEV, Suspension system for EV and HEV, Braking Systems for EV, Tyres for EVs, Material and Manufacturing considerations in EV/HEV. EV in Bus and Truck segment                                                                                                                                                            |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |

|           |                                                                                                                                                                  |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                                         |
| 1         | Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004 |
| 2         | Babu A K, Electric and Hybrid Vehicles, Khanna Book Publishing, 2023.                                                                                            |
| 3         | Babu A K, Automotive Electrical and Electronics, Khanna Book Publishing, 2024                                                                                    |
| 4         | Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010.                                                                               |
| 5         | James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.                                                                                  |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                  |        |   |   |   |        |
|----------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 5<br>THERMAL & FLUID ENGINEERING (MINORS)<br>MEM32 | Scheme | L | T | P | Credit |
|                                                                                  |        | 3 | 1 | 0 | 04     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                               |
|-----|-------------------------------------------------------------------------------|
| CO1 | Relate the thermodynamic laws to engineering systems and processes.           |
| CO2 | Apply the second law of thermodynamics.                                       |
| CO3 | Utilize concepts of fluid mechanics.                                          |
| CO4 | Solve appropriate mode of heat transfer while analyzing engineering problems. |
| CO5 | Compare the different types of power cycles.                                  |
| CO6 | Evaluate the different types of refrigeration systems.                        |

|    |                                                                                                                                                                                                                                                                                                                                                                                                      |                   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                      |                   |
|    | <b>INTRODUCTION TO THERMODYNAMICS</b>                                                                                                                                                                                                                                                                                                                                                                | <b>(10 Hours)</b> |
|    | Classical & statistical thermodynamics, Thermodynamic: system, properties, states, processes, cycle & equilibrium, Zeroth law of thermodynamics, Concept of Work & Heat, Pure Substance, Phase Diagrams, Mollier diagram, Ideal Gas Equation, Concept of Enthalpy, First law of thermodynamics for cycle & process, Statements of second law of thermodynamics, Carnot cycle and Concept of Entropy. |                   |
|    | <b>FLUID MECHANICS &amp; MACHINES</b>                                                                                                                                                                                                                                                                                                                                                                | <b>(12 Hours)</b> |
|    | Classification of fluid, Fluid properties, Fluid statics, Fluid kinematics, Fluid dynamics, Boundary layer phenomenon, Hydraulic turbines and pumps                                                                                                                                                                                                                                                  |                   |
|    | <b>HEAT TRANSFER</b>                                                                                                                                                                                                                                                                                                                                                                                 | <b>(08 Hours)</b> |
|    | Modes of heat transfer: conduction, convection and radiation; Heat exchanger: basic types of heat exchangers, fouling factors, LMTD, Effectiveness – NTU methods of design                                                                                                                                                                                                                           |                   |
|    | <b>POWER CYCLES</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>(07 Hours)</b> |
|    | Air standard cycles: Otto, Diesel and Dual Cycles, Fuel air cycles and Actual Cycles, Ideal Rankine cycle, Improvement in Rankine cycle                                                                                                                                                                                                                                                              |                   |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                                                                                                                                          |                  |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
|  | <b>REFRIGERATION &amp; AIR CONDITIONING</b>                                                                                                                                                                                                                                                              | <b>(8 Hours)</b> |
|  | Reversed Carnot cycle, Aircraft refrigeration cycle, Simple vapor compression cycle, Analysis of vapor compression cycle, Simple vapor absorption refrigeration cycle, Psychrometric properties, Preparation of psychrometric charts, Psychrometric processes, Summer and winter air conditioning system |                  |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                  |                  |

|           |                                                                            |
|-----------|----------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                   |
| 1         | Y.A. Cengel and M.A. Boles, Thermodynamics, Tata McGraw Hill, 2017         |
| 2         | White F. M., "Fluids Mechanics", McGraw-Hill Inc., 7th Ed., New York, 2010 |
| 3         | Y. A. Cengel, A. J.Ghajar, Heat and Mass Transfer, McGraw Hill, 2017.      |
| 4         | R. K. Rajput, Thermal Engineering, Laxmi Publications, 2017                |
| 5         | C. P. Arora, Refrigeration and Air conditioning, Tata McGraw Hill, 2017.   |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

| Sr. No.                                           | Subject                      | Code    | Scheme L-T-P | Credits (Min.) | Notional hours of Learning (Approx.) |
|---------------------------------------------------|------------------------------|---------|--------------|----------------|--------------------------------------|
| <b>Sixth Semester (3<sup>rd</sup> year of UG)</b> |                              |         |              |                |                                      |
| 1.                                                | Production Technology        | ME302   | 3-0-2        | 4              | 85                                   |
| 2.                                                | Design of Machine Components | ME304   | 3-1-2        | 5*             | 100                                  |
| 3.                                                | Applied Thermal engineering  | ME306   | 3-1-2        | 5*             | 100                                  |
| 4.                                                | Elective – III               | ME35x   | 3-0-0        | 3              | 55                                   |
| 5.                                                | Institute Elective – II      | ME35x   | 3-0-0        | 3              | 55                                   |
|                                                   |                              |         | <b>Total</b> | <b>20</b>      | <b>395</b>                           |
| 6.                                                | Project Preliminaries        | ME308   | 0-0-4        | 2              | 70                                   |
| 7.                                                | Minor/Honor                  | M/HMEXX | 3-1-0        | 4              | 70                                   |

## (List of Elective / Honors / Minors)

| <b>Elective - III [Semester - VI]</b>          |                                                 |       |
|------------------------------------------------|-------------------------------------------------|-------|
| 1                                              | Finite Element Methods                          | ME352 |
| 2                                              | Tribology in Machine Design                     | ME354 |
| 3                                              | Electric Vehicles                               | ME356 |
| 4                                              | Rocket Propulsion                               | ME358 |
| 5                                              | Elements of Gas Turbine                         | ME360 |
| 6                                              | Unconventional Machining Processes              | ME362 |
| 7                                              | Tooling for Manufacturing                       | ME364 |
| 8                                              | Logistics & Supply Chain                        | ME366 |
| 9                                              | Plant Layout & Material Handling                | ME368 |
| <b>Institute Elective - II [Semester - VI]</b> |                                                 |       |
| 1                                              | Robotics                                        | ME370 |
| 2                                              | Mechanics of Composite Materials                | ME372 |
| 3                                              | Fatigue, Fracture and Failure Analysis          | ME374 |
| 4                                              | Automobile Engineering                          | ME376 |
| 5                                              | Energy and Buildings                            | ME378 |
| 6                                              | Jet Propulsion                                  | ME380 |
| 7                                              | Machine Learning for Mechanical Engineers       | ME382 |
| 8                                              | Welding Technology                              | ME384 |
| 9                                              | Data Analytics in Smart Manufacturing           | ME386 |
| 10                                             | Design for Additive Manufacturing               | ME388 |
| <b>Honors</b>                                  |                                                 |       |
| 1                                              | Machinery Fault Diagnosis and Signal Processing | MEHD3 |
| 2                                              | Design and Optimization of Thermal Systems      | MEHT3 |
| 3                                              | Micro and Nano Manufacturing                    | MEHM3 |
| 4                                              | Hydro and Wind Energy                           | MEHE3 |
| <b>Minors</b>                                  |                                                 |       |
| 1                                              | Manufacturing Processes                         | MEM33 |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                   |        |   |   |   |        |
|-------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>PRODUCTION TECHNOLOGY<br>ME302 | Scheme | L | T | P | Credit |
|                                                                   |        | 3 | 0 | 2 | 04     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                                      |
|-----|--------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Explain the terms related to metrology.                                                                                              |
| CO2 | Apply measurement techniques for measuring length, angle and taper, screw thread parameters, gear parameters, and surface roughness. |
| CO3 | Design limit gauges for checking internal and external dimensions of components.                                                     |
| CO4 | Illustrate mechanism and state applications of metal forming processes.                                                              |
| CO5 | Analyze metal forming processes such as rolling, extrusion, wire-drawing, and forging.                                               |
| CO6 | Identify probable defects due to rolling, extrusion, wire-drawing, and forging processes and their remedies.                         |

|    |                                                                                                                                                                                         |                   |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                |                   |
|    | <b>INTRODUCTION TO METROLOGY</b>                                                                                                                                                        | <b>(04 Hours)</b> |
|    | Definition of metrology, important terms such as error, zero error, accuracy, precision, sensitivity, true value, Classification of methods of measurement, Uncertainty of measurement. |                   |
|    | <b>LIMITS, FITS, AND GAUGES</b>                                                                                                                                                         | <b>(08 Hours)</b> |
|    | Limit, Fit, Types of fit, Tolerance, Tolerance analysis, Interchangeability, Types of gauges, Design of limit gauges.                                                                   |                   |
|    | <b>MEASUREMENT</b>                                                                                                                                                                      | <b>(08 Hours)</b> |
|    | Measurement of length, angle and taper; Screw thread measurement, Gear measurement, Surface roughness measurement, Geometrical Dimensioning and Tolerancing (GD & T).                   |                   |
|    | <b>INTRODUCTION TO METAL FORMING</b>                                                                                                                                                    | <b>(04 Hours)</b> |
|    | Plastic deformation and yield criteria, Material behavior in metal forming processes, Role of temperature in in forming processes, Classification of metal forming processes.           |                   |
|    | <b>MECHANISM OF METAL FORMING PROCESSES</b>                                                                                                                                             | <b>(10 Hours)</b> |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

## Department of Mechanical Engineering

### B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                                                                       |                   |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Mechanism of bulk deformation processes (rolling, forging, wire drawing, and extrusion) and sheet metal forming processes, Applications of metal forming processes, Mechanism and applications of high energy rate forming processes. |                   |
|  | <b>ANALYSIS OF BULK DEFORMATION PROCESSES AND MACHINE TOOLS</b>                                                                                                                                                                       | <b>(11 Hours)</b> |
|  | Analysis of forging, rolling, drawing, and extrusion processes; Machine tools for different forming processes.                                                                                                                        |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                               |                   |

|           |                                                                                               |
|-----------|-----------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Practical</b>                                                                              |
| 1         | To calibrate given indicating micrometer/micrometer                                           |
| 2         | To find angle of V-block, dovetails, taper, and radius of circular arc                        |
| 3         | To calibrate given gear tooth vernier, find the tooth thickness and module                    |
| 4         | To find the pitch, effective diameter, best wire size of the given screw threads              |
| 5         | To find the angle of external taper, taper of tapered hole, taper of tapered ring             |
| 6         | To draw stress-strain behavior for model material                                             |
| 7         | To measure the force required in extrusion                                                    |
| 8         | To find flow stress of the given material and to plot a graph of forging ratio vs flow stress |

|           |                                                                                                               |
|-----------|---------------------------------------------------------------------------------------------------------------|
| <b>4.</b> | <b>Books Recommended</b>                                                                                      |
| 1         | K. Bewoor and V. A. Kulkarni, Engineering metrology and measurements, Tata McGraw Hill Education, 2017        |
| 2         | N. V. Raghavendra, L. Krishnamurthy, Engineering Metrology and Measurements, Oxford publishers, 2013          |
| 3         | R. K. Jain, Engineering Metrology, Khanna Publishers, 1997                                                    |
| 4         | S. Kalpakjian, S. R. Schmid, Manufacturing Engineering and Technology, 7 <sup>th</sup> Edition, Pearson, 2018 |
| 5         | A. Ghosh and A. K. Mallik, Manufacturing Science, East West Press New Delhi, 2010                             |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                        |        |   |   |   |        |
|----------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br><b>DESIGN OF MACHINE COMPONENTS</b><br><b>ME304</b> | Scheme | L | T | P | Credit |
|                                                                                        |        | 3 | 1 | 2 | 05     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                 |
|-----|-----------------------------------------------------------------|
| CO1 | Apply design procedures to spur, helical, bevel and worm gear.  |
| CO2 | Develop gear boxes for various industrial applications.         |
| CO3 | Discuss various types of mechanical brakes and clutches.        |
| CO4 | Elaborate the journal and antifriction bearings.                |
| CO5 | Design belt drives, pulley, flywheel and power lifting devices. |
| CO6 | Apply the design concepts to miscellaneous machine components.  |

|    |                                                                                                                                                                                                                                                                                                                 |                   |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                        |                   |
|    | <b>Statistical Considerations in Machine Design</b>                                                                                                                                                                                                                                                             | <b>(03 Hours)</b> |
|    | Probabilistic approach to design, statistical analysis of tolerances, reliability, statistical factor of safety, MTBF, reliability of systems in series and parallel                                                                                                                                            |                   |
|    | <b>Design of Power Transmission Elements</b>                                                                                                                                                                                                                                                                    | <b>(17 Hours)</b> |
|    | Design of belt drives, selection of flat and V- belts, design of pulleys and flywheels, design of gear drives – spur, helical, bevel and worm gear drives, design of single and multistage speed reducers. Design of gear boxes: Types of gear boxes, design of machine tool gear boxes using preferred numbers |                   |
|    | <b>Design of Clutches and Brakes</b>                                                                                                                                                                                                                                                                            | <b>(05 Hours)</b> |
|    | Types of clutches, design of single and multiple plate clutches, cone and centrifugal clutch, design of block brake, pivoted shoe brake, long shoe brake, internal shoe brake, simple and differential band brake                                                                                               |                   |
|    | <b>Design of Bearings</b>                                                                                                                                                                                                                                                                                       | <b>(08 Hours)</b> |
|    | Design of hydrodynamic journal bearings, classification, material selection, Sommerfeld number and use of charts for the estimation of minimum film thickness, temperature rise, flow quantity etc. design of pressure fed and self-contained                                                                   |                   |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering

B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                      |                   |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | bearings, rolling contact bearings, classification, selection factors affecting bearing life, bearing assembly and lubrication                       |                   |
|  | <b>Miscellaneous Machine Elements</b>                                                                                                                | <b>(08 Hours)</b> |
|  | Selection of steel wire rope for hoists and cranes, crane hooks, design of pressure vessels: thin and thick cylinder, stresses and types of failures |                   |
|  | <b>Design of I.C. Engine Components</b>                                                                                                              | <b>(04 Hours)</b> |
|  | Piston, cylinder and connecting rod.                                                                                                                 |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                              |                   |

|                     |                                                                                                                                                           |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3. Practical</b> |                                                                                                                                                           |
| 1                   | Drawing of involute gear profile                                                                                                                          |
| 2                   | Design of spur gear                                                                                                                                       |
| 3                   | Design of helical gear.                                                                                                                                   |
| 4                   | Design of journal bearing                                                                                                                                 |
| 5                   | Design of two stage speed reducer gear box with its kinematic arrangement                                                                                 |
| 6                   | Design and drawing of automobile clutch of any of the following<br>a. Plate clutch,<br>b. Centrifugal clutch,<br>c. Multi-plate clutch.                   |
| 7                   | Design and drawing of the any of the brake from following:<br>a. External expanding brake,<br>b. Internal expanding brake,<br>c. Differential band brake. |
| 8                   | Design and drawing of hook block                                                                                                                          |
| 9                   | Selection and mounting of rolling element bearing                                                                                                         |
| 10                  | Design of bevel gear                                                                                                                                      |

|                             |                                                                                                                     |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>5. Books Recommended</b> |                                                                                                                     |
| 1                           | R. G. Budynas and K. Nisbett, Shigley's Mechanical Engineering Design, 11 <sup>th</sup> Edition, McGraw Hill, 2020. |
| 2                           | R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, 6 <sup>th</sup> Edition, Wiley, 2017.   |
| 3                           | V. B. Bhandari, Design of Machine Elements, 4 <sup>th</sup> Edition, Tata McGraw Hill, 2016.                        |
| 4                           | R. L. Norton, Machine Design, 5 <sup>th</sup> Edition, Pearson Education India Ltd., 2014.                          |
| 5                           | M. F. Spotts, Design of Machine Elements, Pearson Education India Ltd., 2004.                                       |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                         |        |   |   |   |        |
|-------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>Applied Thermal Engineering<br>ME306 | Scheme | L | T | P | Credit |
|                                                                         |        | 3 | 1 | 2 | 05     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                          |
|-----|--------------------------------------------------------------------------------------------------------------------------|
| CO1 | Evaluate the losses in actual cycle of IC engines                                                                        |
| CO2 | Compare the combustion and emission of CI and SI engines.                                                                |
| CO3 | Prepare heat balance sheet and calculate SI/CI engine efficiencies.                                                      |
| CO4 | Justify the different types of refrigeration systems.                                                                    |
| CO5 | Determine the properties of moist air and present air conditioning processes on psychrometric chart psychrometric chart. |
| CO6 | Compute cooling/heating loads for designing air conditioning systems plants.                                             |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |
|    | <b>INTRODUCTION TO INTERNAL COMBUSTION ENGINES</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>(01 Hours)</b> |
|    | Historical Development in IC Engines, General Specifications of I C Engines                                                                                                                                                                                                                                                                                                                                                         |                   |
|    | <b>FUEL AIR CYCLE AND ACTUAL CYCLE ANALYSIS</b>                                                                                                                                                                                                                                                                                                                                                                                     | <b>(05 Hours)</b> |
|    | Significance of cycle analysis. Effect of variation in specific heat of gases, Dissociation effect, Time burning Loss and other losses affecting the performance of engine cycle. Comparison of air standard cycle-fuel air cycle and actual cycle analysis.                                                                                                                                                                        |                   |
|    | <b>COMBUSTION IN SI AND CI ENGINE</b>                                                                                                                                                                                                                                                                                                                                                                                               | <b>(12 Hours)</b> |
|    | Stages of combustion in SI Engine, Factors affecting various stages of combustion in SI Engine, Stages of combustion in CI Engine, delay period, factors affecting stages of combustion in CI Engine, Difference of Ignition Delay and ignition lag, Abnormal combustion phenomenon in SI and CI engine and its prevention. Knocking/detonation and its effects, Comparison of normal and abnormal combustion in SI and CI Engines. |                   |
|    | <b>ENGINE EMISSION AND CONTROL</b>                                                                                                                                                                                                                                                                                                                                                                                                  | <b>(04 Hours)</b> |
|    | Pollutant – Sources and types – Effect on environment and human health – formation of Nox, Hydrocarbon Emission Mechanism – Carbon Monoxide Formation – Particulate emissions – Methods of controlling Emissions – Catalytic converters and Particulate Traps – Selective                                                                                                                                                           |                   |



**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat****Department of Mechanical Engineering****B.Tech. –III, Mechanical Engineering (As per NEP)**

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Catalytic Reduction (SCR) – Diesel Oxidation Catalyst (DOC). – Emission Norms and Driving cycles – Indian and Euro norms.                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |
|  | <b>AIR REFRIGERATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>(03 Hours)</b> |
|  | Reversed Carnot cycle, Bell Coleman cycle, Aircraft refrigeration cycle, Boot strap system, Actual cycle, Ramming, Compression and Turbine efficiencies, Coefficient of performance.                                                                                                                                                                                                                                                                                                                                                      |                   |
|  | <b>VAPOUR COMPRESSION REFRIGERATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>(04 Hours)</b> |
|  | Simple vapour compression cycle, Analysis of vapour compression cycle, Modifications and performance improvements to simple vapour compression system, Multistage vapour compression system, properties of refrigerants.                                                                                                                                                                                                                                                                                                                  |                   |
|  | <b>VAPOUR ABSORPTION REFRIGERATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>(03 Hours)</b> |
|  | Comparison between vapour absorption and vapour compression system, Aqua-Ammonia and Lithium Bromide absorption system                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |
|  | <b>PSYCHROMETRY OF AIR CONDITIONING PROCESSES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>(13 hours)</b> |
|  | Psychrometric properties, Preparation of psychrometric charts, Psychrometric Processes – Mixing process, Sensible heating, Sensible cooling, Humidification, Dehumidification, Cooling and Dehumidification, Heating and humidification, Bypass factor, Apparatus dew point, Sensible heat factor, Air washer, evaporative cooling, Adiabatic humidification, Efficiency of humidification, Summer and Winter air conditioning system, Load calculations, comfort conditions, Central air conditioning plant, Pressure drop in air ducts. |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                   |

|           |                                                                                                   |
|-----------|---------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Practical (Any 5 Practical from S. No. 1 to 7; and other 5 Practical from S. No. 8 to 14)</b>  |
| 1         | Study of Valve Timing/Port Timing Diagram for Engine System                                       |
| 2         | Performance test of 4 stroke Petrol Engine.                                                       |
| 3         | Performance test of 4 stroke Diesel Engine.                                                       |
| 4         | Heat Balance Preparation for 4 stroke Diesel Engine                                               |
| 5         | Heat Balance Preparation for 4 stroke Petrol Engine                                               |
| 6         | Determination of friction power of multi cylinder petrol engine using Morse Test Method           |
| 7         | Determination of friction power of single/multi cylinder petrol engine using Willan's Line Method |
| 8         | To conduct performance test on vapour compression refrigeration system                            |
| 9         | To study tools and instruments used in refrigeration and air conditioning                         |
| 10        | To determine psychrometric properties of air.                                                     |
| 11        | To conduct performance test on air conditioning system                                            |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering

B.Tech. –III, Mechanical Engineering (As per NEP)

|    |                                                                                      |
|----|--------------------------------------------------------------------------------------|
| 12 | To conduct performance test on Ice plant                                             |
| 13 | To conduct performance test on vapour absorption system – Electrolux- Domestic type. |
| 14 | To conduct performance test on desert cooler                                         |

|    |                                                                                                 |
|----|-------------------------------------------------------------------------------------------------|
| 5. | <b>Books Recommended</b>                                                                        |
| 1  | V. Ganesan, Internal Combustion Engine, Fourth Edition, Tata Mc-Graw Hill, 2017                 |
| 2  | M.L. Mathur and R.P. Sharma, Internal Combustion Engine, Dhanpat Rai Publications, 2010         |
| 3  | R. Stone, Introduction to Internal Combustion Engines, Fourth edition, Palgrave Macmillan, 2012 |
| 4  | R. J. Dossat, Principles of Refrigeration, Pearson Education India, 2002                        |
| 5  | C. P. Arora, Refrigeration and Air conditioning, Tata McGraw Hill, 2017                         |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                    |        |   |   |   |        |
|------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>FINITE ELEMENT METHODS (ELECTIVE –III)<br>ME352 | Scheme | L | T | P | Credit |
|                                                                                    |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                      |
|-----|--------------------------------------------------------------------------------------|
| CO1 | Explain the fundamental concepts of the theory of the finite element method          |
| CO2 | Develop element characteristic equation and generation of global equation.           |
| CO3 | Determine stress, strain, loads and potential energy for flexure components          |
| CO4 | Select suitable boundary conditions to a global equation for bars, trusses and beams |
| CO5 | Show the governing FE equations for solving 1D and 2D problems                       |
| CO6 | Apply the FE method for thermal, potential flow and transient problems               |

|    |                                                                                                                                                                                                                                                                                                                           |            |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                  |            |
|    | INTRODUCTION                                                                                                                                                                                                                                                                                                              | (07 Hours) |
|    | Basic concepts of FEM, Matrix notations, Exact solution, Approximate solution, general procedure for finite element analysis, various approximate methods, types of elements, Interpolation and shape functions                                                                                                           |            |
|    | STIFFNESS (DISPLACEMENT) METHOD                                                                                                                                                                                                                                                                                           | (08 Hours) |
|    | Introduction to Stiffness matrix, stiffness matrix for spring element, Global stiffness matrix, application of boundary conditions and forces, essential and natural boundary conditions, elimination method, penalty methods, element stresses and strains, Potential Energy approach to derive spring element Equations |            |
|    | TRUSS STRUCTURES                                                                                                                                                                                                                                                                                                          | (07 Hours) |
|    | Stiffness Matrix for Bar Element, Global stiffness matrix for bar elements, computation of stress and strain for bar. Other residual method for one dimensional (1-D) bar problems                                                                                                                                        |            |
|    | FLEXURE ELEMENTS                                                                                                                                                                                                                                                                                                          | (07 Hours) |
|    | Beam theory, Beam stiffness matrix, Global beam stiffness matrix, equivalence load for various distributed loads, potential energy and Galerkin's method for beam elemental equation                                                                                                                                      |            |
|    | FINITE ELEMENTS FOR TWO-DIMENSIONS                                                                                                                                                                                                                                                                                        | (08 Hours) |





**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

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|  |                                                                                                                                                                                                       |                   |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Introduction to plane stress and plane strain, constant – strain triangle (CST) stiffness matrix, body and surface force for two-dimensional element, finite element solution of plane stress problem |                   |
|  | <b>APPLICATIONS OF FEA IN ENGINEERING</b>                                                                                                                                                             | <b>(08 Hours)</b> |
|  | Plane elasticity, Heat conduction, Potential flow, Transient problems and Computer implementation                                                                                                     |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                               |                   |

|           |                                                                                                                             |
|-----------|-----------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                    |
| 1         | R.D. Cook, Concepts and Applications of Finite Element Analysis, 4 <sup>th</sup> Edition, John Wiley & Sons, 2007           |
| 2         | D.L. Logan, A first course in the finite element method, 5 <sup>th</sup> Edition, Cengage Learning, 2012                    |
| 3         | J.N. Reddy, an Introduction to the Finite Element Method, 5 <sup>th</sup> edition, McGraw Hill, x 2017                      |
| 4         | T.R. Chandrupatla & A.D Belagundu, Finite Elements in Engineering, 4 <sup>th</sup> Edition, Pearson, 2015                   |
| 5         | O.C. Zienkiewicz, R.L Taylor and J.Z Zhu, The finite element method its basis and fundamentals, 7th edition, Elsevier, 2013 |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

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B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                         |        |   |   |   |        |
|-----------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>TRIBOLOGY IN MACHINE DESIGN (ELECTIVE –III)<br>ME354 | Scheme | L | T | P | Credit |
|                                                                                         |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                    |
|-----|------------------------------------------------------------------------------------|
| CO1 | Express the concept of tribo-design and principles of tribology.                   |
| CO2 | Demonstrate the lubrication and wear behavior of lower and higher kinematic pairs. |
| CO3 | Evaluate the performance parameters for sliding element bearings.                  |
| CO4 | Calculate the performance characteristics of rolling element bearings.             |
| CO5 | Analyze the lubrication behavior of involute gears.                                |
| CO6 | Understand gear failures.                                                          |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |
|    | <p>Introduction to the concept of tribo-design: Specific principles of tribo-design, tribological problems in machine elements.</p> <p>Basic principles of tribology: Sliding friction, relative motion contact between relative motion in bodies, friction due to adhesion, deformation, energy dissipation during friction, types of wear and their mechanisms, wear in lubricated contacts and film lubrication.</p>                                                         | (15 Hours) |
|    | <p>Friction, lubrication and wear in lower kinematic pairs: Concept of friction angle, friction in screws with a square and triangular threads, plate, cone and centrifugal clutches, drives utilizing friction force, frictional aspects of brake design and tribo-design aspects of mechanical seals.</p> <p>Friction, lubrication and wear in higher kinematic pairs: Loads acting on contact area, traction in contact zone, rolling friction and cam-follower systems.</p> | (15 Hours) |





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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <p>Sliding-element bearings: Derivation of Reynolds equation, hydrostatic and thrust bearings, journal bearings, gas bearings, steady-state analysis of fluid-film bearings, modern developments in journal bearing design, selection and design of thrust bearings.</p> <p><b>Rolling-contact bearings:</b> Analysis of friction in rolling contact bearings, deformations and kinematics of rolling element bearings, lubrication analysis of rolling contact bearings.</p> <p>Lubrication and efficiency of involute gears: Generalities of gear design, lubrication regimes, gear failure due to scuffing, gear pitting, design aspects of gear lubrication and efficiency of gears.</p> | <b>(15 Hours)</b> |
| <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |

|                             |                                                                                                                      |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>3. Books Recommended</b> |                                                                                                                      |
| 1                           | A. Harnoy, Bearing Design in Machinery: Engineering Tribology and Lubrication, CRC Press, 2002.                      |
| 2                           | G. Stachowiak and A. Batchelor, Engineering Tribology, 4 <sup>th</sup> Ed., Elsevier Science, 2014.                  |
| 3                           | B. C. Majumdar, Introduction to Tribology of Bearings, S. Chand Limited, 2008.                                       |
| 4                           | B. Bhushan, Introduction to Tribology, Wiley, 2013.                                                                  |
| 5                           | R. Gohar and H. Rahnejat, Fundamentals of Tribology, 3 <sup>rd</sup> Ed., World Scientific Publishing Company, 2018. |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                               |        |   |   |   |        |
|-------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>ELECTRIC VEHICLES (ELECTIVE –III)<br>ME356 | Scheme | L | T | P | Credit |
|                                                                               |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                                                       |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Get acquainted with the types of EVs, their comparison with ICE Vehicles and general aspects of major components of EV including architecture design. |
| CO2 | Apply basic know how of electric, electronic and battery fundamentals to solve related problems linked with EV.                                       |
| CO3 | Evaluate performance of Li Ion batteries and work out problems pertaining to various aspects of EV Batteries.                                         |
| CO4 | Explain the performance of electric motors, control units, BMS systems and calculate the sizing requirement.                                          |
| CO5 | Explain the mechanical aspects and EV charging related aspects of EV.                                                                                 |
| CO6 | Work out prospects of EVs taking into account economics, various Policies safety aspects of EVs.                                                      |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |
|    | INTRODUCTION TO ELECTRIC VEHICLES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | (04 Hours) |
|    | Historical Developments in Hybrid Electric Vehicles and Electric Vehicles. Prospects and Challenges of EVs, Comparison of EVs with I C Engines vehicles, Advantages and disadvantages of electric vehicles, Major components of Electric Vehicles. Types of Electric Vehicle and components, Electric Vehicle Architecture Design, Electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV. |            |
|    | ELECTRICAL AND ELECTRONICS FUNDAMENTALS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | (06 Hours) |
|    | Electricity, Elements of Electricity, Ohm's law, Electric Circuits, DC measuring instruments, Actions of electric current, Voltage generation, Electrochemical cells, Electronics fundamentals, Semiconductors, diodes, transistors, Integrated circuits.                                                                                                                                                                                                                                                                                                                          |            |
|    | BATTERY FUNDAMENTALS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | (06 Hours) |
|    | Dry Cell, Wet Cell, Vehicle Batteries, Functions of Batteries, Construction of Lead Acid Battery, Battery Grids, Electrolyte, Container, Cell Cover, Vent Plug, Cell and Battery Arrangement, Electrochemical Action, Charging and Discharging, Basics of Alkaline Battery, Nickel Cadmium                                                                                                                                                                                                                                                                                         |            |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

## Department of Mechanical Engineering

### B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Battery, Nickel Metal Hydride Battery, Sodium Sulphur Battery, Aluminium Air Battery, Battery selection criteria. Jump starting, Boost charging, Maintenance Free Battery, Good practices for battery extended life.                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |
| <b>LITHIUM-ION BATTERY FOR EV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>(06 Hours)</b> |
| Why Li-Ion Battery, Advantages over other conventional Batteries, Charging and Discharging reactions, Battery Performance Assessment, Battery Characteristics, Battery Terminology - Battery Ratings and Capacity, Cyclic Life, Thermal Run Away, Battery Efficiency, Battery Testing, Battery charging and discharging calculation, Cell Selection and sizing, Battery layout design, Battery Pack Configuration, Battery Pack material and design consideration, Construction, Battery Pack Sizing, Thermal Design of Battery Pack, Heat Load Determination and Thermal Management of Battery. Alternative energy storage devices           |                   |
| <b>ELECTRIC DRIVE AND CONTROLLER</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>(06 Hours)</b> |
| Requirements of Motors, Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor, Central Motor Vs in Wheel Motors, Motor Controllers, Component sizing, Physical locations, Mechanical connection of motor, Electrical connection of motor. Battery Management System and Electric Management System. Functions of Control Unit.                                                                                                                                                                                                                                                                                  |                   |
| <b>MECHANICAL ASPECTS OF EV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>(06 Hours)</b> |
| Calculating the Rolling Resistance, calculating the grade resistance, Calculating the Acceleration Force, Finding the Total Tractive Effort, Torque Required on the Drive Wheel, Drive Cycle and Energy requirement per km calculations, Chassis and body considerations for EV and HEV, Steering System for EV and HEV, Suspension system for EV and HEV, Braking Systems for EV, Tyres for EVs, Material and Manufacturing considerations in EV/HEV. EV in Bus and Truck segment.                                                                                                                                                           |                   |
| <b>EV CHARGING TECHNOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>(06 Hours)</b> |
| Classification of different charging technology for EV charging station, introduction to Grid-to-Vehicle, Vehicle to Grid (V2G) or Vehicle to Buildings (V2B) or Vehicle to Home (V2H) operations, bi-directional EV charging systems, energy management strategies used in hybrid and electric vehicle, Wireless power transfer (WPT) technique for EV charging, Type of Charging station, Selection and Sizing of charging station, Components of charging station, Single line diagram of charging station, Charging and Energy Infrastructure Planning, Depot Infrastructure and Equipment Planning, Charging and Swapping Infrastructure |                   |
| <b>SAFETY, POLICIES, REGULATIONS AND ECONOMICS OF EV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>(05 Hours)</b> |
| Fire Safety of Electric Vehicles, Evacuation of Buses – Safe exit from Vehicles, Key driving parameters for introduction of E buses in urban environment, FAME Scheme, Payback and commercial model of charging stations, Policies in India, Std. IEC IEC 60068-2 (1,2,14,30), IEC 61683, IEC 60227, IEC 60502 IEC 60947 part I, II, III, IEC 61215                                                                                                                                                                                                                                                                                           |                   |
| <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

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|    |                                                                                                                                                                  |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3. | <b>Books Recommended</b>                                                                                                                                         |
| 1  | Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004 |
| 2  | Babu A K, Electric and Hybrid Vehicles, Khanna Book Publishing, 2023.                                                                                            |
| 3  | Babu A K, Automotive Electrical and Electronics, Khanna Book Publishing, 2024                                                                                    |
| 4  | Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010                                                                                |
| 5  | James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003                                                                                   |





**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

| B.Tech. III (DoME) Semester – 6<br>ROCKET PROPULSION (ELECTIVE –III)<br>ME358 | Scheme | L | T | P | Credit |
|-------------------------------------------------------------------------------|--------|---|---|---|--------|
|                                                                               |        | 3 | 0 | 0 | 03     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                                              |
|-----|------------------------------------------------------------------------------|
| CO1 | Demonstrate rocket propulsion theory and discuss classifications of rockets. |
| CO2 | Illustrate rocket nozzle types and its performance.                          |
| CO3 | Examine Trajectory of Rocket.                                                |
| CO4 | Explain types of chemical rockets and details of its propellant.             |
| CO5 | Analyse combustion process and ignition in rocket propellant engines.        |
| CO6 | Describe non-chemical rocket engine.                                         |

|           |                                                                                                                                                                                                                                |                   |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                |                   |
|           | <b>INTRODUCTION &amp; OVERVIEW</b>                                                                                                                                                                                             | <b>(2 Hours)</b>  |
|           | Classification of Propulsive device, types of rocket engines, application of rocket engines.                                                                                                                                   |                   |
|           | <b>THERMODYNAMICS AND AERODYNAMICS OF ROCKET ENGINES</b>                                                                                                                                                                       | <b>(3 Hours)</b>  |
|           | Laws of thermodynamics, combustion parameters, rudiments of gas dynamics.                                                                                                                                                      |                   |
|           | <b>ROCKET PERFORMANCE PARAMETERS</b>                                                                                                                                                                                           | <b>(5 Hours)</b>  |
|           | Ideal rocket performance, thrust equation, Total impulse and Specific Impulse, Specific impulse efficiency, volume specific impulse, impulse-to-weight ratio, energy balance, efficiencies and coefficients of rocket engines. |                   |
|           | <b>NOZZLES FOR ROCKET ENGINES</b>                                                                                                                                                                                              | <b>(4 Hours)</b>  |
|           | Types of nozzles, thrust-vectoring nozzles, Losses and performance analysis of rocket engines.                                                                                                                                 |                   |
|           | <b>TRAJECTORY ANALYSIS AND ROCKET DESIGN</b>                                                                                                                                                                                   | <b>(4 Hours)</b>  |
|           | Forces acting on vehicles, rocket equation, space flight and its orbit, interplanetary transfer path, single stage and multi stage rocket engine.                                                                              |                   |
|           | <b>CHEMICAL ROCKET PROPELLANTS</b>                                                                                                                                                                                             | <b>(12 Hours)</b> |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

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|  |                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Classification of Chemical propellants, Solid propellants, Liquid propellants, Gel Propellants and Hybrid Propellants.                                                                                                                                                                                                                                                                                                |                   |
|  | <b>ROCKET PROPELLANTS ENGINES</b>                                                                                                                                                                                                                                                                                                                                                                                     | <b>(12 Hours)</b> |
|  | Solid-propellant rocket engines—Burning mechanism, Propellant Burning and regression rates, Propellant grain configuration, Ignition system. Liquid-propellant rocket engines—Classification of engines, Combustion of Liquid Propellants, Combustion chamber geometry, Ignition systems, cooling systems, Hybrid-propellant rocket engines— combustion chamber, grain configuration, Ignition of hybrid propellants. |                   |
|  | <b>NON-CHEMICAL ROCKET ENGINES</b>                                                                                                                                                                                                                                                                                                                                                                                    | <b>(3 Hours)</b>  |
|  | Electric propulsion, nuclear rocket engines, Solar Energy rockets.                                                                                                                                                                                                                                                                                                                                                    |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                               |                   |

|           |                                                                                                                                                      |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                             |
| 1         | G. P. Sutton and O. Biblarz, Rocket Propulsion Elements, John Wiley & Sons, Inc., 2016.                                                              |
| 2         | Heister, Stephen D., William E. Anderson, Timothée L. Pourpoint, and R. Joseph Cassady. Rocket propulsion. Vol. 47. Cambridge University Press, 2019 |
| 3         | J. D. Mattingly, Elements of Propulsion: Gas Turbines & Rockets, the American Institute of Aeronautics and Astronautics, 2006                        |
| 4         | H. S. Mukunda, understanding aerospace propulsion, Interline Publishing, Bengaluru, India, 2017                                                      |
| 5         | P. G. Hill, and C. R. Peterson, Mechanics and thermodynamics of propulsion Wesley Publishing Company, USA, 1992                                      |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                     |        |   |   |   |        |
|-------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>ELEMENTS OF GAS TURBINE (ELECTIVE –III)<br>ME360 | Scheme | L | T | P | Credit |
|                                                                                     |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                   |
|-----|-------------------------------------------------------------------------------------------------------------------|
| CO1 | Describe different cycle arrangements of gas turbines and their applications.                                     |
| CO2 | Analyse ideal and actual cycle.                                                                                   |
| CO3 | Recognize the principles of design, construction and operation of the major components of the gas turbine engine. |
| CO4 | Predict the effect of compressibility and flow behaviour within the gas turbine components.                       |
| CO5 | Solve 1-D design problems based on 1-D duct with variable area, friction and heat transfer.                       |
| CO6 | Estimate the position and effect of normal shock within the 1-D compressible flow duct.                           |

|    |                                                                                                                                                                                                                                                                                           |            |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                  |            |
|    | FUNDAMENTALS OF ROTATING MACHINES                                                                                                                                                                                                                                                         | (03 Hours) |
|    | Energy equation, General Fluid dynamics, Efficiency of rotating machines.                                                                                                                                                                                                                 |            |
|    | BASIC CYCLE AND APPLICATION OF GAS TURBINE PLANT                                                                                                                                                                                                                                          | (10 Hours) |
|    | Brayton cycle, Basic & actual cycle analysis, Reheat, Intercooling and regeneration, General overview for applications of Gas turbine plant. Practical Cycles and their Analysis.                                                                                                         |            |
|    | MAJOR COMPONENTS AND SUPPORTING SYSTEMS OF GAS TURBINE PLANT<br>COMPRESSOR                                                                                                                                                                                                                | (12 Hours) |
|    | Centrifugal flow compressor, Components & their functions, Velocity triangle, Performance, Slip factor, Prewhirl, Choking, Surging & stalling, Degree of reaction.<br><br>Axial flow compressor, Components and their functions, Velocity triangle, Work done factor, Degree of Reaction. |            |
|    | COMBUSTION CHAMBER                                                                                                                                                                                                                                                                        | (10 Hours) |



## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

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#### B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                                                                                                                  |                   |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Types, Design requirements, Arrangement of combustion chamber, Losses & efficiency, Factors affecting combustion chamber design and performance, Requirements of Combustion chamber, Mixing and dilution.                                                                        |                   |
|  | <b>TURBINE</b>                                                                                                                                                                                                                                                                   | <b>(10 Hours)</b> |
|  | Impulse and Reaction Turbines, multistage machines, Blade and Stage efficiency, Velocity triangles of single stage machine, Blade loading and flow coefficient.<br>Types, Materials for Turbine blades & blade cooling, Air, Lubrication, Starting & Power transmission systems. |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                          |                   |

|           |                                                                                   |
|-----------|-----------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                          |
| 1         | Yahya S.M., Fundamentals of Compressible Flow, New Age International, 2003        |
| 2         | Radhakrishnan T., Gas Dynamics, Prentice Hall India, 2003                         |
| 3         | Boyce Meherwan P., Gas Turbine Engineering Hand Book, Gulf Publication, 2003      |
| 4         | Cohen Henry and Rogers G. F. C., Gas Turbine Theory, Addison Wesley Longman, 1996 |
| 5         | Ganesan V., Gas Turbine, Tata McGraw Hill, 2003                                   |





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|-------------------------------------------------------------------------------------------------------------------------------|---------------|----------|----------|----------|---------------|
| <b>B.Tech. III (DoME) Semester – 6</b><br><b>UNCONVENTIONAL MACHINING PROCESSES</b><br><b>(ELECTIVE –III)</b><br><b>ME362</b> | <b>Scheme</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>Credit</b> |
|                                                                                                                               |               | <b>3</b> | <b>0</b> | <b>0</b> | <b>03</b>     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                                                                                       |
|-----|-----------------------------------------------------------------------------------------------------------------------|
| CO1 | Classify non-traditional machining processes and analyze mechanical energy based non-traditional machining processes. |
| CO2 | Illustrate and analyze chemical and electro chemical energy-based processes.                                          |
| CO3 | Outline and analyze thermo-electric energy-based processes.                                                           |
| CO4 | Explain nano finishing processes.                                                                                     |
| CO5 | Show influence of process parameters on performance of non-traditional machining processes.                           |
| CO6 | Demonstrate hybrid machining processes and applications.                                                              |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                   |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                   |
|           | <b>INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>(10 Hours)</b> |
|           | Introduction; Need for unconventional machining processes; Classification of unconventional machining processes; Applications, advantages and limitations of unconventional machining processes; Abrasive jet machining, working principles, equipment, evaluate material removal rate; Abrasive water jet machining, working principles, equipment; Ultrasonic machining their principles, evaluate material removal rate, equipment, effect of process parameters, applications, advantages and limitations. |                   |
|           | <b>CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>(10 Hours)</b> |
|           | Principles, equipments, evaluate material removal rate, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.                                                                                                                                                                                                                                              |                   |
|           | <b>THERMO-ELECTRIC ENERGY BASED PROCESSES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>(10 Hours)</b> |
|           | Principles, equipments, evaluate material removal rate, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.                                                                                                                                                                                                                    |                   |



## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

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|  |                                                                                                                                                                                                                                                                |                   |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>NANO FINISHING PROCESSES</b>                                                                                                                                                                                                                                | <b>(09 Hours)</b> |
|  | Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining; Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing. |                   |
|  | <b>HYBRID NON-TRADITIONAL MACHINING PROCESSES</b>                                                                                                                                                                                                              | <b>(06 Hours)</b> |
|  | Introduction; Various hybrid machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different unconventional machining processes.                      |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                        |                   |

|                             |                                                                                                                                                                                   |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3. Books Recommended</b> |                                                                                                                                                                                   |
| 1                           | Adithan. M., Unconventional Machining Processes, Atlantic, New Delhi, India, 2009                                                                                                 |
| 2                           | Carl Sommer, Non-Traditional Machining Handbook, Advance Publishing., United States, 2000                                                                                         |
| 3                           | V. K. Jain, Advanced machining processes; Allied publishers, 2009                                                                                                                 |
| 4                           | Golam Kibria, Bhattacharyya B. and Paulo Davim J., Non-traditional Micromachining Processes: Fundamentals and Applications, Springer International Publishing., Switzerland, 2017 |
| 5                           | Jagadeesha T., Non-Traditional Machining Processes, I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017                                                         |





|                                                                                                     |        |   |   |   |        |
|-----------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br><b>TOOLING FOR MANUFACTURING (ELECTIVE –III)</b><br><b>ME364</b> | Scheme | L | T | P | Credit |
|                                                                                                     |        | 3 | 0 | 0 | 03     |

**1. Course Outcomes (COs):**

**At the end of the course, students will be able to**

|     |                                                                                             |
|-----|---------------------------------------------------------------------------------------------|
| CO1 | Choose appropriate cutting tools required for producing a component.                        |
| CO2 | Illustrate cutting tool and tool holder designation systems.                                |
| CO3 | Select suitable locating and clamping devices for a given component for various operations. |
| CO4 | Analyze and design a jig/fixture for a given simple component.                              |
| CO5 | Explain various press tools and press tool operations.                                      |
| CO6 | Classify and explain various die casting and injection moulding dies.                       |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |
|           | <b>INTRODUCTION TO TOOL DESIGN</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>(09 Hours)</b> |
|           | Tooling, requirements of a tool designer, general tool design procedure, tool engineering functions and its importance to enhance productivity and quality. Review of cutting tool materials. Tool angles and signature, Carbide inserts grades - ISO designation and applications, tool holders for turning-ISO designation. Solid type tool, brazed tip tool, throwaway indexable insert types, coated carbides and chip breakers. Design of single point cutting tools: Design of shank dimensions using strength and rigidity considerations for rectangular, square and round cross section and selection of tool geometry.                            |                   |
|           | <b>DESIGN OF MULTI POINT CUTTING TOOLS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>(09 Hours)</b> |
|           | Design of Multi Point Cutting Tools: Types of drills, Drill bit design - elements like back taper, web thickness, land width, margin, flute length and cross section and selection of tool geometry. Re-sharpening of drill bit. Tool holders for milling, different tapers used for mounting tool holders in milling, ISO designation. Tool mounting systems. Design of milling cutters: Design of elements like number of teeth and height, circular pitch, body thickness, chamfer width, fillet radius and selection of tool geometry. Profile sharpened and form relieved milling cutters. Re-sharpening of side and face milling cutter and end mill. |                   |
|           | <b>JIGS AND FIXTURES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>(09 Hours)</b> |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

## Department of Mechanical Engineering

### B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Jigs and Fixtures: Functions and differences between jigs and fixtures, advantages in mass production, design principles, economics of jigs and fixtures. Location: 3-2-1 Principle of location, different types of locating elements. Clamping: Principles of clamping, types of clamping devices, and power clamping. Drill bushes; Drill jigs: Different types, exercises of designing jigs for simple components. Fixture Design: Turning fixtures, milling fixtures, grinding fixtures, fixturing for CNC machining centers, and modular fixtures. Design exercises on fixtures for turning and milling for simple components         |                   |
|  | <b>PRESS TOOLS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>(09 Hours)</b> |
|  | Press tools: Classification and working of power presses. Concept and calculations of press tonnage and shut height of a press, components of a simple die, press tool operation, die accessories, shearing action in punch & die, clearance, shear on punch and die, Centre of pressure, and strip layout. Simple, progressive, compound, combination and inverted dies. Design problems on blanking and piercing dies for simple components. Bending dies: Introduction, bend allowance, spring back, edge bending die design.                                                                                                           |                   |
|  | <b>DRAWING DIES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>(09 Hours)</b> |
|  | Drawing dies: Single action, double action and triple action dies, factors affecting drawing and drawing die design. Design of drawing dies for simple components. Die casting: Die casting alloys, terminology- core, cavity, sprue, slug, fixed and movable cores, finger cams, draft, ejector pins and plates, gate, goose nozzle, over-flow, platten, plunger, runner, vent, water-line etc. Types of Dies: Single cavity, multi cavity dies, combination dies, unit dies, advantages and disadvantages of types of dies; finishing, trimming and inspection of die casting components, safety, and modern trends in die casting dies. |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |

|           |                                                                                                                                |
|-----------|--------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                       |
| 1         | Cyril Donaldson, George H. Le Cain, and V. C. Goold, Tool Design, 5 <sup>th</sup> Edition, Mc Graw Hill Education, 2017        |
| 2         | P. N. Rao, Manufacturing Technology-I&II, 4 <sup>th</sup> Edition, Mc Graw Hill Education, 2013                                |
| 3         | P. H. Joshi, Jigs and Fixtures, 3 <sup>rd</sup> Edition, Mc Graw Hill Education, 2010                                          |
| 4         | John G. Nee, William Dufraine, John W. Evans, Fundamentals of Tool Design, Mark Hill. Society of Manufacturing Engineers, 2010 |
| 5         | Frank W. Wilson, Fundamentals of Tool Design, PHI publications, 2012                                                           |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

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|--------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>LOGISTICS & SUPPLY CHAIN (ELECTIVE –III)<br>ME366 | Scheme | L | T | P | Credit |
|                                                                                      |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                 |
|-----|-----------------------------------------------------------------------------------------------------------------|
| CO1 | Explain the concepts of logistics, supply chain, supply chain performance, supply chain drivers and metrics.    |
| CO2 | Identify the key factors for distribution network and to develop the framework for network design decisions.    |
| CO3 | Evaluate the forecast, aggregate plan and sales & operation plan for supply chain.                              |
| CO4 | Solve deterministic and probabilistic inventory control models for evaluating the supply chain inventory level. |
| CO5 | Demonstrate the supply chain management analytics.                                                              |
| CO6 | Apply analytics for solving the supply chain problems.                                                          |

|    |                                                                                                                                                                                    |            |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                           |            |
|    | LOGISTICS MANAGEMENT                                                                                                                                                               | (05 Hours) |
|    | Logistics Management-An Introduction, Key actors, Classification of Logistics Applications, Total logistics cost, Logistics to supply chain Management.                            |            |
|    | BUILDING A STRATEGIC FRAMEWORK TO ANALYSE SUPPLY CHAINS                                                                                                                            | (05 Hours) |
|    | Historical evolution of supply chain, Understanding the supply chain, supply chain performance: achieving strategic fit, supply chain drivers and metrics and case studies.        |            |
|    | DESIGNING THE SUPPLY CHAIN NETWORK                                                                                                                                                 | (06 Hours) |
|    | Designing distribution networks and applications to e-business, network design in the supply chain, network design in an uncertain environment, and case studies.                  |            |
|    | PLANNING DEMAND AND SUPPLY IN A SUPPLY CHAIN                                                                                                                                       | (10 Hours) |
|    | Demand forecasting strategy in a supply chain, aggregate planning in a supply chain, sales and operation planning: Planning supply and demand in a supply chain, and case studies. |            |
|    | PLANNING AND MANAGING INVENTORIES IN A SUPPLY CHAIN                                                                                                                                | (09 Hours) |



## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering

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|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Managing economies of scale in a supply chain: cycle inventory, managing uncertainty in a supply chain: safety inventory, determining the optimal level of product availability, and case studies. |                   |
|  | <b>SUPPLY CHAIN MANAGEMENT ANALYTICS</b>                                                                                                                                                           | <b>(10 Hours)</b> |
|  | Techniques for evaluating supply chain, evaluating disaster risk in supply chain, Managing bullwhip effect, Supplier selection analysis, Transportation mode analysis and Warehouse storage.       |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                            |                   |

|           |                                                                                                                                                                            |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                                                   |
| 1         | S. Chopra and P. Meindel, Supply Chain Management: Strategy, Planning, and Operation, 6th Edition, Pearson Education, 2016                                                 |
| 2         | M. Christopher. Logistics and Supply Chain Management: Strategies for Reducing cost and Improving Services, 4 <sup>th</sup> Edition, Pearson Education, 2011               |
| 3         | D. Simchi-Levi, P. Kaminsky, E. Simchi-Levi, Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies, 3rd Edition Revised, McGraw-Hill/Irwin, 2008 |
| 4         | J. F. Shapiro, Modeling the Supply Chain, 2nd Wadsworth Publishing Co Inc., 2006                                                                                           |
| 5         | J. Heizer, B. Render, C. Munson and A. Sachan, Operations Management, 12th Edition, Pearson Education, 2017                                                                |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

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|----------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>PLANT LAYOUT & MATERIAL HANDLING (ELECTIVE –III)<br>ME368 | Scheme | L | T | P | Credit |
|                                                                                              |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                              |
|-----|------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Explain the capabilities of selecting suitable plant location considering various criteria.                                  |
| CO2 | Demonstrate the knowledge of factory buildings used in industries and its importance.                                        |
| CO3 | Compare various types of plant layouts used in industries and solve the related problem using various evaluation techniques. |
| CO4 | Evaluate the optimum layouts using optimization techniques.                                                                  |
| CO5 | Identify suitable material handling equipment used in industries as per the requirement.                                     |
| CO6 | Analyze material handling equipment used in industries as per the requirement.                                               |

|    |                                                                                                                                                                                                           |            |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                  |            |
|    | INTRODUCTION                                                                                                                                                                                              | (04 Hours) |
|    | Need of plant layout; basic objectives of plant layout; types of plant layouts; types of production systems.                                                                                              |            |
|    | PLANT LOCATION                                                                                                                                                                                            | (06 Hours) |
|    | Introduction to plant location, Influence of location on plant layout, plant location selection factors, Models for the plant location selection: median model, gravity model; plant location selection.  |            |
|    | INDUSTRIAL BUILDING                                                                                                                                                                                       | (04 Hours) |
|    | Relationship between the building and layout, considerations in industrial building design; types of factory buildings: single storey/horizontal buildings and multi storey buildings.                    |            |
|    | PLANT LAYOUT                                                                                                                                                                                              | (07 Hours) |
|    | Definitions of plant layout, types of plant layouts: product layout, process layout/functional type layout, fixed position layout, group technology layout/cellular layout; advantages and disadvantages. |            |



**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

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|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>EVALUATION OF LAYOUTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>(16 Hours)</b> |
|  | Product layout/assembly line evaluation algorithms: largest candidate rule; Kilbridge and Wester method; ranked positional weights method. Process layout evaluation: qualitative and quantitative factors; layout cost evaluation; comparing two layout layout; computerized relative allocation of facilities technique (CRAFT); equal area and unequal area facility layout problems. Assignment model for addition of new facilities/machine to the existing layout. Group technology layout evaluation: part families and machine cells; rank order clustering technique. |                   |
|  | <b>MATERIAL HANDLING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>(08 Hours)</b> |
|  | Principles of material handling, Factors considered for material handling equipment selection, Types of material handling equipment: load formation equipment, positioning equipment, conveyers, cranes and hoists, industrial trucks, elevators, storage equipment, etc.; material handling equipment selection.                                                                                                                                                                                                                                                              |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |

|           |                                                                                                                              |
|-----------|------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                     |
| 1         | M. P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 5 <sup>th</sup> Edition, Pearson, 2018 |
| 2         | R. Panneerselvam, Production and Operations Management, 3 <sup>rd</sup> Edition, Prentice Hall India, 2012                   |
| 3         | T. H. Allegri, Material Handling, Principles and Practice, CBS Publishers, New Delhi, 2017.                                  |
| 4         | P.B. Mahapatra, Computer Aided Production Management, 1 <sup>st</sup> Edition, Prentice Hall India, 2004                     |
| 5         | S. Roy, Introduction to Material Handling, 2nd Edition, New Age International (P) Ltd, 2017                                  |





**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

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|----------------------------------------------------------------------------------------|---------------|----------|----------|----------|---------------|
| <b>B.Tech. III (DoME) Semester – 6<br/>ROBOTICS (INSTITUTE ELECTIVE –II)<br/>ME370</b> | <b>Scheme</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>Credit</b> |
|                                                                                        |               | <b>3</b> | <b>0</b> | <b>0</b> | <b>03</b>     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                   |
|-----|---------------------------------------------------|
| CO1 | Explain the basics of robotic systems.            |
| CO2 | Apply the concept of robot arm kinematics.        |
| CO3 | Compare statics and dynamics of robots.           |
| CO4 | Examine manipulator trajectories.                 |
| CO5 | Analyse control of robot manipulators.            |
| CO6 | Illustrate robot programming, sensing and vision. |

|           |                                                                                                                                                                                                                                                                                                                                   |                   |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                   |                   |
|           | <b>INTRODUCTION</b>                                                                                                                                                                                                                                                                                                               | <b>(04 Hours)</b> |
|           | Background, Historical development, Robot manipulators, Robot anatomy, Coordinate systems, Work envelope, Types and classification, Specifications, Actuators and drives                                                                                                                                                          |                   |
|           | <b>MATHEMATICAL REPRESENTATION OF ROBOTS</b>                                                                                                                                                                                                                                                                                      | <b>(07 Hours)</b> |
|           | Rotations and translation of vectors, Transformations and Euler angle representations, Homogenous transformations, Representation of position and orientation of a rigid body, Homogeneous transformations, Denavit-Hartenberg (D-H) notations and parameters, Representation of joints, link representation using D-H parameters |                   |
|           | <b>Forward and Inverse Kinematics</b>                                                                                                                                                                                                                                                                                             | <b>(10 Hours)</b> |
|           | Introduction, Forward and inverse kinematics problems<br><br>Velocity and Statics analysis:<br><br>Linear and angular velocity of links, Velocity propagation, Jacobians for robotic manipulators, Statics and force transformation of robotic manipulators, Singularity analysis                                                 |                   |
|           | <b>ROBOT ARM DYNAMICS</b>                                                                                                                                                                                                                                                                                                         | <b>(07 Hours)</b> |
|           | Introduction, Forward and inverse dynamics, Mass and inertia of links, Lagrangian formulation for equations of motion for robotic manipulators, Newton-Euler formulation method                                                                                                                                                   |                   |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
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|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>TRAJECTORY PLANNING AND CONTROL</b>                                                                                                                                                                                                    | <b>(12 Hours)</b> |
|  | Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Force Control of manipulators |                   |
|  | <b>ROBOT PROGRAMMING, SENSING AND VISION</b>                                                                                                                                                                                              | <b>(05 Hours)</b> |
|  | Robot Programming. Introduction to sensing, and vision in robotics                                                                                                                                                                        |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                   |                   |

|           |                                                                                                                    |
|-----------|--------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                           |
| 1         | A Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2006                               |
| 2         | J. Craig John, Introduction to robotics: Mechanics & Control, Addison-Wesley, 1986                                 |
| 3         | R. J. Schilling, Fundamentals of Robotics Analysis and Control, Prentice Hall of India, 2006                       |
| 4         | K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw Hill, 1987 |
| 5         | S.K.Saha, Introduction to Robotics, McGraw Hill (2008)                                                             |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

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|----------------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>MECHANICS OF COMPOSITE MATERIALS<br>(INSTITUTE ELECTIVE –II)<br>ME372 | Scheme | L | T | P | Credit |
|                                                                                                          |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                        |
|-----|----------------------------------------------------------------------------------------|
| CO1 | Understating of the composite materials and their constituents.                        |
| CO2 | Explain the mechanical properties and behaviour of composite materials.                |
| CO3 | Apply constitutive equations of composite materials at micro and macro levels.         |
| CO4 | Determine stresses and strains relation in composites materials.                       |
| CO5 | Describe the different types of laminated composites and their failure mechanisms.     |
| CO6 | Use the concepts of failure criterias, critically and evaluate the Solve the problems. |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                |                   |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                       |                   |
|    | <b>INTRODUCTION</b>                                                                                                                                                                                                                                                                                                                                                                                            | <b>(05 Hours)</b> |
|    | Introduction of composite materials, Need for composites, Types of composites, Metal matrix, Ceramic matrix and Carbon-Carbon composites, Polymer matrix composites                                                                                                                                                                                                                                            |                   |
|    | <b>COMPOSITE CONSTITUENT MATERIALS</b>                                                                                                                                                                                                                                                                                                                                                                         | <b>(05 Hours)</b> |
|    | Characteristics of thermosetting and thermoplastic resins. Characteristics of Glass, Carbon and Kevlar Fibers, method of making and properties, types of fiber materials                                                                                                                                                                                                                                       |                   |
|    | <b>MICROMECHANICS OF UNIDIRECTIONAL FIBER COMPOSITES</b>                                                                                                                                                                                                                                                                                                                                                       | <b>(10 Hours)</b> |
|    | Prediction of elastic properties using strength of materials approach. Introduction to elasticity based approach for prediction of elastic constants (concentric cylinder model). Empirical relations (Halpin- Tsai) for elastic property prediction. Comparison of different approaches with examples. Prediction of strength and discussion on failure modes, Prediction of thermal and diffusion properties |                   |
|    | <b>SHORT FIBERCOMPOSITES</b>                                                                                                                                                                                                                                                                                                                                                                                   | <b>(05 Hours)</b> |
|    | Load transfer length, Prediction of elastic properties. Elastic property calculation for random fiber composites                                                                                                                                                                                                                                                                                               |                   |
|    | <b>ANALYSIS OF ORTHOTROPIC LAMINA</b>                                                                                                                                                                                                                                                                                                                                                                          | <b>(10 Hours)</b> |
|    | Generalized Hooke's law, Material symmetry. Orthotropic materials and transversely isotropic materials. Transformation of stress and strain. Stress-strain relations for transversely isotropic lamina under plane stress in material axis and off axis Failure theories (Maximum stress, strain, Tsai-Hill and Tsai-Wu)                                                                                       |                   |
|    | <b>ANALYSIS OF LAMINATED COMPOSITES</b>                                                                                                                                                                                                                                                                                                                                                                        | <b>(10 Hours)</b> |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering

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|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Description of laminate sequence and type of laminates (UD, Symmetric and Asymmetric, Balanced, Quasi-Isotropic) etc. Classical laminate theory (CLT). Failure analysis of laminates using CLT: First ply failure, progressive failure analysis. Hygro-thermal stresses in laminates. Discussion on interlaminar stresses |
|  | (Total Contact Time: = 45 Hours)                                                                                                                                                                                                                                                                                          |

|           |                                                                                                                            |
|-----------|----------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                   |
| 1         | K. Kautar, Mechanics of Composite Materials, 2nd Edition, CRC Press, 2006                                                  |
| 2         | J. N. Reddy, Mechanics of laminated composite plates and shells theory and analysis, 2nd Edition, CRC press, 2003          |
| 3         | R. M. Jones, Mechanics of composite materials, 2nd Edition, Taylor and Francis, 2018                                       |
| 4         | K. Serope, S. Steven, Manufacturing engineering and technology, 8 <sup>th</sup> edition, Pearson, 2019                     |
| 5         | P. K. Mallick, Fiber-reinforced composites: Materials, Manufacturing, and Design, 3 <sup>rd</sup> Edition, CRC Press, 2007 |





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|----------------------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>FATIGUE, FRACTURE AND FAILURE ANALYSIS<br>(INSTITUTE ELECTIVE –II)<br>ME374 | Scheme | L | T | P | Credit |
|                                                                                                                |        | 3 | 0 | 0 | 03     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                                                                                                  |
|-----|----------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Understand the micro and macro fatigue mechanism                                                                                 |
| CO2 | Design a machine member against fatigue using stress-life and strain-life analysis.                                              |
| CO3 | Analyze the three-dimensional principal stresses of a member from stress at a point                                              |
| CO4 | Build damage-tolerant components using fracture mechanics concepts                                                               |
| CO5 | Evaluate the crack propagation life and initiation life                                                                          |
| CO6 | Apply the theories of linear elastic fracture mechanics concepts in design and estimate the fracture toughness of the materials. |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |
|           | <b>INTRODUCTION AND MECHANISM OF FATIGUE</b>                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>(04 Hours)</b> |
|           | Fatigue failure, Relation between static strength and fatigue strength. Environmental effects of fatigue, Macro and Micro Aspects of Fatigue -Fracture surfaces -Fatigue Mechanism Crack nucleation Crack growth Fatigue failure                                                                                                                                                                                                                                      |                   |
|           | <b>DESIGN AGAINST FATIGUE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>(11 Hours)</b> |
|           | Different approaches to fatigue, Stress-life approach (S-N curves) for Ferrous and non ferrous materials, Types of fatigue loading, design against high cyclic fatigue, Goodman's criteria, Soderburg and Gerber's Parabola. Strain-Life Analysis - Design against low cyclic fatigue, Fundamental Material Behavior under low cyclic fatigue, Variable amplitude loading, Damage Parameters and Combined Loading (Miner rule), Methods to enhance fatigue resistance |                   |
|           | <b>THEORY OF ELASTICITY AND PLASTICITY</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>(08 Hours)</b> |
|           | Notion of stress and strain, Principal Stresses and Principal Coordinates, Maximum shearing Stress, Stress tensors, Compatibility equations, Generalized Hooke's Law, General formulation of elastic problem, Tresca's and von-Mises'Yield Criteria                                                                                                                                                                                                                   |                   |
|           | <b>FRACTURE MECHANICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>(07 Hours)</b> |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

## Department of Mechanical Engineering B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                                                                                                                   |                   |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Introduction to fracture mechanics, Fracture modes, Microscopic theories of fracture: Ductile and cleavage fracture, ductile-brittle transition, inter-granular fracture; Griffith's fracture Criterion and Irwin's Fracture Criterion, Linear elastic fracture mechanics (LEFM). |                   |
|  | <b>CRACK PROPAGATION AND ANALYSIS</b>                                                                                                                                                                                                                                             | <b>(08 Hours)</b> |
|  | Crack tip Plastic Zone, Methods for Measuring Fracture Toughness, Crack Initiation and Crack Propagation under different loading conditions, Closure Effects, Stress Raisers                                                                                                      |                   |
|  | <b>INTRODUCTION TO FAILURE</b>                                                                                                                                                                                                                                                    | <b>(07 Hours)</b> |
|  | Philosophy and criteria of material selection, Different types of failures, Fundamental causes of failure, General practice in failure analysis, ductile brittle and fatigue failure. Application of theories of fracture mechanics in design and materials development           |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                           |                   |

|           |                                                                                                        |
|-----------|--------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                               |
| 1         | S. P. Timoshenko and J. N. Goodier, Theory of Elasticity, 3rd Edition, McGraw Hill, 2017               |
| 2         | R. B. Charlie and A. Chaudhary, Failure Analysis of Engineering Materials, McGraw Hill, New York, 2001 |
| 3         | K. Hellan, Introduction to Fracture Mechanics, McGraw-Hill, 1984                                       |
| 4         | S. Mohammadi, Extended finite element method, 1 <sup>st</sup> Edition, Blackwell, 2007                 |
| 5         | P. Kumar, Elements of fracture mechanics, Tata McGraw Hill, New Delhi, 2017                            |





**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                                          |               |          |          |          |               |
|----------------------------------------------------------------------------------------------------------|---------------|----------|----------|----------|---------------|
| <b>B.Tech. III (DoME) Semester – 6<br/>AUTOMOBILE ENGINEERING<br/>(INSTITUTE ELECTIVE –II)<br/>ME376</b> | <b>Scheme</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>Credit</b> |
|                                                                                                          |               | <b>3</b> | <b>0</b> | <b>0</b> | <b>03</b>     |

**1. Course Outcomes (COs):****At the end of the course, students will be able to**

|     |                                                                                                    |
|-----|----------------------------------------------------------------------------------------------------|
| CO1 | Apply various design considerations for engine components & understand various automobile systems. |
| CO2 | Distinguish the different allied systems of Automobile.                                            |
| CO3 | Evaluate vehicle performance based on estimated traction forces and resistance.                    |
| CO4 | Compare basic layout and structure of EV and IC Engine vehicles.                                   |
| CO5 | Work out battery and motor sizing for various applications in two, three and four-wheeler segment. |
| CO6 | Analyse Bus Rapid Transit Systems.                                                                 |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |
|           | <b>AUTOMOBILE SYSTEMS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>(12 Hours)</b> |
|           | Introduction to chassis frame and body, Mechanical systems, SI and CI Engine Fuel Systems, Ignition systems, Lubrication Systems, Cooling System, Intake and Exhaust Systems. Material and Design Consideration for Engine Components such as Piston, Cylinder, Piston Rings, Connecting Rod, Cam Shafts, Crank Shafts etc.                                                                                                                                                                        |                   |
|           | <b>AUTOMOBILE ALLIED SYSTEMS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>(12 Hours)</b> |
|           | Transmission systems: Basics of clutch, Drive mechanism and Gear box, Basics of steering, suspension and braking system, Vehicle Electrical Systems: Charging system, Starting system, Ignition system, Lighting System, Accessories; Electronic Ignition System: types, capacitive discharge, Automotive Wiring, Lighting System, Electronic Engine Management: Sensors, ECUs and Actuators, Micro Computer controlled devices: Electronic dash board, Automotive HVAC Systems, Wheels and Tyres. |                   |
|           | <b>VEHICLE PERFORMANCE, TESTING AND RECYCLING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>(06 Hours)</b> |
|           | Forces and couples on wheels, Vehicle drag, Power for propulsion, Traction and tractive effort, Calculation of equivalent weight, Determination of CG, Stability of vehicle, Maximum                                                                                                                                                                                                                                                                                                               |                   |



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|  |                                                                                                                                                                                                                                                                                                                                                                                                             |                   |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | acceleration, Maximum tractive effort, and reactions for different drives, Stability of vehicle taking a turn, Multipurpose vehicles, Automotive Indian Standards, Vehicle Recycling.                                                                                                                                                                                                                       |                   |
|  | <b>INTRODUCTION TO ELECTRIC VEHICLES</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>(02 Hours)</b> |
|  | Limitations of Internal Combustion Engines as Prime Mover, History of EV and EV Systems, Structure of Electric Vehicle covering basic Components, General Layout, Govt. policies on EV and its impact on automotive sector.                                                                                                                                                                                 |                   |
|  | <b>EV POWER TRAIN</b>                                                                                                                                                                                                                                                                                                                                                                                       | <b>(11 Hours)</b> |
|  | Basic components like Battery, DC-AC Converters, Electric Motors, DC-DC Converters, Transmissions and ECUs. Battery and Motor Selection, Calculations for Motor and battery sizing for EV for Two, Three and Four-Wheeler Applications, Thermal Management of Battery, Initial acceleration, rated vehicle velocity, maximum velocity and maximum gradeability of EV, Basic architecture of EV Drive Train. |                   |
|  | <b>URBAN TRANSPORT</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>(02 Hours)</b> |
|  | Urban Bus Specifications, Bus Rapid Transit Systems.                                                                                                                                                                                                                                                                                                                                                        |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                     |                   |

|                             |                                                                                                  |
|-----------------------------|--------------------------------------------------------------------------------------------------|
| <b>3. Books Recommended</b> |                                                                                                  |
| 1                           | W.H.Crouse, Automobile Mechanics, Tata McGraw Hill, New Delhi, 2007.                             |
| 2                           | H.Heinz, Vehicle and Engine Technology, Arnold, London, 1999                                     |
| 3                           | Joseph Kent, Handbook of Electric Vehicles, Clanrye International, 2015                          |
| 4                           | H. Yamagata, The Science and Technology of Materials in Automotive Engine, CRC Press Inc., 2005  |
| 5                           | A.K.Babu, Automobile Electricals and Electronics, Second edition, Khanna Publishing, Delhi, 2020 |





|                                                                                           |        |   |   |   |        |
|-------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>ENERGY AND BUILDINGS (INSTITUTE ELECTIVE –II)<br>ME378 | Scheme | L | T | P | Credit |
|                                                                                           |        | 3 | 0 | 0 | 03     |

**1. Course Outcomes (COs):**

**At the end of the course, students will be able to**

|     |                                                                                                                           |
|-----|---------------------------------------------------------------------------------------------------------------------------|
| CO1 | Express the importance of climate, building and energy.                                                                   |
| CO2 | Illustrate daylight and lightings for energy efficiency perspective.                                                      |
| CO3 | Analyze ventilation and air quality in buildings.                                                                         |
| CO4 | Estimates building load and develop methods to reduce it.                                                                 |
| CO5 | Evaluate energy efficiency in buildings.                                                                                  |
| CO6 | Distinguish green building rating systems, life cycle and environmental assessments and contribution of renewable energy. |

|           |                                                                                                                                                                                    |                   |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                    |                   |
|           | <b>INTRODUCTION</b>                                                                                                                                                                | <b>(04 Hours)</b> |
|           | Understanding building energy use, concepts of energy efficiency potential in buildings, effect of climates on building energy usage.                                              |                   |
|           | <b>DAYLIGHT AND LIGHTING IN BUILDINGS</b>                                                                                                                                          | <b>(05 Hours)</b> |
|           | Introduction, Types of technology, design considerations, operation and maintenance, relevant codes and standards.                                                                 |                   |
|           | <b>VENTILATION AND AIR QUALITY IN BUILDINGS</b>                                                                                                                                    | <b>(08 Hours)</b> |
|           | Types of ventilation systems, Passive and active methods of heating and cooling with their layouts, performance of room air distribution systems, cooling comfort in hot climates. |                   |
|           | <b>ESTIMATION OF BUILDING LOADS</b>                                                                                                                                                | <b>(12 Hours)</b> |
|           | Steady state method, Network method, Numerical method, Correlations, Computer packages for carrying out thermal design of buildings and predicting performance                     |                   |
|           | <b>ENERGY EFFICIENCY IN BUILDINGS</b>                                                                                                                                              | <b>(08 Hours)</b> |



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|  |                                                                                                                                                                         |                   |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Energy efficient building technologies, energy efficiency policies, Building codes and standards, energy efficient building operation, evaluation of energy efficiency. |                   |
|  | <b>ADVANCES IN BUILDING</b>                                                                                                                                             | <b>(08 Hours)</b> |
|  | Life cycle perspective and environmental assessment of buildings. Renewable energy in buildings; Sustainable Building Rating Systems.                                   |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                 |                   |

|           |                                                                                                                                                                       |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                                              |
| 1         | David Thorpe, Energy Management in Buildings, The Earthscan Expert Guide, 1st Ed. 2014, Routledge                                                                     |
| 2         | Mili Majumdar, Energy-efficient Buildings in India, The Energy and Resources Institute (TERI), 2001                                                                   |
| 3         | S. Boemi, Olatz Irulegi, Mattheos Santamouris, Energy Performance of Buildings, Energy Efficiency and Built Environment in Temperate Climates., 2016, Springer Nature |
| 4         | A Athienitis, W O'Brien, Modelling, Design, and Optimization of Net-Zero Energy Buildings, first published 2015                                                       |
| 5         | Bruce D. Hunn and Charles B. Fundamentals of Building Energy Dynamics: 4 (Solar Heat Technologies), The MIT Press, 1996                                               |





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B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                     |        |   |   |   |        |
|-------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>JET PROPULSION (INSTITUTE ELECTIVE –II)<br>ME380 | Scheme | L | T | P | Credit |
|                                                                                     |        | 3 | 0 | 0 | 03     |

**1. Course Outcomes (COs):****At the end of the course, students will be able to**

|     |                                                                                                                         |
|-----|-------------------------------------------------------------------------------------------------------------------------|
| CO1 | Explore various components of gas turbine cycles with basic cycle variations for application in jet propulsion systems. |
| CO2 | Evaluate engine component characteristics and engine matching-off design.                                               |
| CO3 | Analyse the thermodynamics and performance parameters of jet propulsion systems.                                        |
| CO4 | Illustrate ideal and actual air breathing gas turbine cycles with performance curves.                                   |
| CO5 | Decide fluid flow properties for different performance parameters.                                                      |
| CO6 | Apply the concepts of jet propulsion and solve the problems.                                                            |

|    |                                                                                                                                                                                                                                                                                                                  |                   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                         |                   |
|    | <b>INTRODUCTION &amp; OVERVIEW</b>                                                                                                                                                                                                                                                                               | <b>(08 Hours)</b> |
|    | Introduction of gas turbine cycle and various components of GTP, Introduction of jet propulsion systems, Computation of stagnation properties, Basic components of air breathing engines, Inlet ducts for aircraft gas turbines, Brief idea about compressor, combustion chamber, turbine, and aircraft nozzles. |                   |
|    | <b>ENGINE COMPONENT CHARACTERISTICS AND ENGINE MATCHING</b>                                                                                                                                                                                                                                                      | <b>(07 Hours)</b> |
|    | Component Characteristics, Engine Matching Off-design.                                                                                                                                                                                                                                                           |                   |
|    | <b>AIR BREATHING ENGINES</b>                                                                                                                                                                                                                                                                                     | <b>(14 Hours)</b> |
|    | Performance parameters for air breathing engine (Thrust, Efficiency, Aircraft Range, Take-off Thrust, Specific Fuel Consumption), Basic gas generator & its variations, Turbojet, Turboprop, Turbofan, Pulse jet, Ram jet, Scramjet, Thrust Augmentation.                                                        |                   |
|    | <b>PARAMETRIC CYCLE ANALYSIS OF IDEAL AND ACTUAL AIR BREATHING GAS TURBINE ENGINES.</b>                                                                                                                                                                                                                          | <b>(16 Hours)</b> |



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|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Parametric Cycle Analysis of Ideal Turbo Jet Engine, Real Turbojet Cycle, Analysis of Turbofan Engine, Analysis of Turbofan Engine, Analysis of Turboprop Engine, Ramjet & Scramjet Engine, Numerical. |
|  | (Total Contact Time: = 45 Hours)                                                                                                                                                                       |

|    |                                                                                                                               |
|----|-------------------------------------------------------------------------------------------------------------------------------|
| 3. | <b>Books Recommended</b>                                                                                                      |
| 1  | M. S. Ramgir and M. J. Sable, Gas Turbine & Jet propulsion, Technical Publications, 2006.                                     |
| 2  | J. D. Mattingly, Elements of Propulsion: Gas Turbines & Rockets, the American Institute of Aeronautics and Astronautics, 2006 |
| 3  | V. Ganeshan, Gas Turbines, Tata McGraw Hill Education Pvt. Ltd, 2010                                                          |
| 4  | S. M. Yahya, Fundamentals of Compressible flow, New Age International Publishers, 2005                                        |
| 5  | G. P. Sutton and O. Biblarz, Rocket Propulsion Elements, John Wiley & Sons, Inc., 2016                                        |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

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|-------------------------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>MACHINE LEARNING FOR MECHANICAL<br>ENGINEERS (INSTITUTE ELECTIVE –II)<br>ME382 | Scheme | L | T | P | Credit |
|                                                                                                                   |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                                                                                                                                                          |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Understand different types of machine learning and map problems to different classes of machine learning algorithms.                                                                                                                                     |
| CO2 | Describe and apply machine-learning algorithms including decision trees, naïve Bayes, and logistic regression.                                                                                                                                           |
| CO3 | Design and implement advanced neural network architectures, including Multilayer Perceptrons (MLPs), Convolutional Neural Networks (CNNs), and Recurrent Neural Networks (RNNs) (including LSTM and GRU variants), to solve complex real-world problems. |
| CO4 | Utilize Bayesian Regression, Binary Trees, Random Forests, Support Vector Machines (SVM), Naïve Bayes, k-Means, k-Nearest Neighbors (kNN), Gaussian Mixture Models (GMM), and Expectation Maximization (EM) to analyze and optimize mechanical systems   |
| CO5 | Evaluate the performance of algorithms and compare different machine learning techniques.                                                                                                                                                                |
| CO6 | Apply structured probabilistic models, Monte Carlo methods, autoencoders, and generative adversarial networks (GANs) to analyze and optimize mechanical systems                                                                                          |

|    |                                                                                                                                                                                                                                          |            |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                 |            |
|    | MATHEMATICAL BASICS                                                                                                                                                                                                                      | (04 Hours) |
|    | Introduction to Machine Learning, Linear Algebra, Probability                                                                                                                                                                            |            |
|    | COMPUTATIONAL BASICS                                                                                                                                                                                                                     | (04 Hours) |
|    | Numerical computation and optimization, Introduction to Machine Learning packages                                                                                                                                                        |            |
|    | LINEAR AND LOGISTIC REGRESSION                                                                                                                                                                                                           | (05 Hours) |
|    | Bias/Variance Tradeoff, Regularization, Variants of Gradient Descent, MLE, MAP, Applications                                                                                                                                             |            |
|    | NEURAL NETWORKS                                                                                                                                                                                                                          | (14 Hours) |
|    | Multilayer Perceptron, Backpropagation, Applications, <b>Convolutional Neural Networks:</b> CNN Operations, CNN architectures, Training, Transfer Learning, Applications, <b>Recurrent Neural Networks:</b> RNN, LSTM, GRU, Applications |            |
|    | CLASSICAL TECHNIQUES                                                                                                                                                                                                                     | (09 Hours) |



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|  |                                                                                                                                               |                   |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, Applications, k-Means, kNN, GMM, Expectation Maximization, Applications, |                   |
|  | <b>ADVANCED TECHNIQUES</b>                                                                                                                    | <b>(09 Hours)</b> |
|  | Structured Probabilistic Models, Monte Carlo Methods, Autoencoders, Generative Adversarial Networks                                           |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                       |                   |

|           |                                                                                                                                                                                                                      |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                                                                                             |
| 1         | Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning (Adaptive Computation and Machine Learning series), The MIT Press, 2016                                                                                |
| 2         | Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2016                                                                                                                                         |
| 3         | Sebastian Raschka, Yuxi (Hayden) Liu, Vahid Mirjalili, Dmytro Dzhulgakov, Machine Learning with PyTorch and Scikit-Learn: Develop machine learning and deep learning models with Python. Packt Publishing Ltd., 2022 |
| 4         | Manaranjan Pradhan, U Dinesh Kumar, Machine Learning using Python, Wiley, 2020                                                                                                                                       |
| 5         | Andreas C. Müller, Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, 2016                                                                                                      |





**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

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|                                                                                         |        |   |   |   |        |
|-----------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>WELDING TECHNOLOGY (INSTITUTE ELECTIVE –II)<br>ME384 | Scheme | L | T | P | Credit |
|                                                                                         |        | 3 | 0 | 0 | 03     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                                                                                  |
|-----|------------------------------------------------------------------------------------------------------------------|
| CO1 | Demonstrate the fundamentals of different welding processes and equipment.                                       |
| CO2 | Analyze the performance of different welding processes.                                                          |
| CO3 | Select a suitable welding process for a particular application.                                                  |
| CO4 | Apply the knowledge of welding fundamentals to solve welding problems.                                           |
| CO5 | Explain the impact of welding operations on health and environment.                                              |
| CO6 | Identify the ethical principles regarding health, safety and legal issues during operations of welding machines. |

|    |                                                                                                                                                                                                                                                                                              |                   |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                     |                   |
|    | <b>INTRODUCTION TO WELDING PROCESSES</b>                                                                                                                                                                                                                                                     | <b>(04 Hours)</b> |
|    | Definition, Terms used in welding, Advantages, Classification of welding processes and their principles in brief with applications.                                                                                                                                                          |                   |
|    | <b>GAS WELDING</b>                                                                                                                                                                                                                                                                           | <b>(04 Hours)</b> |
|    | Introduction & principle of gas welding, Different gases used & their properties, Types of flames, Welding technique and safety Applications of the process.                                                                                                                                 |                   |
|    | <b>BRAZING AND SOLDERING</b>                                                                                                                                                                                                                                                                 | <b>(06 Hours)</b> |
|    | Difference between brazing and soldering, braze welding, Wetting and spreading characteristics, surface tension and contact angle concept, introduction to different brazing and soldering methods (torch, furnace, brazing and soldering consumables, application of brazing and soldering. |                   |
|    | <b>SHIELDED METAL ARC WELDING</b>                                                                                                                                                                                                                                                            | <b>(10 Hours)</b> |



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|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Electric arc, arc starting methods, Arc stability, arc efficiency, arc blow, power sources, voltage-ampere characteristics of power source, electrode polarity, duty cycle, classification and coding of SMAW electrodes.     |                   |
|  | <b>GAS TUNGSTEN ARC WELDING</b>                                                                                                                                                                                               | <b>(05 Hours)</b> |
|  | Gas tungsten arc welding- Principle, Equipments used and welding parameters, Shielding gases and their effect, Advantages, Disadvantages and Applications of the process.                                                     |                   |
|  | <b>GAS METAL ARC WELDING</b>                                                                                                                                                                                                  | <b>(06 Hours)</b> |
|  | Gas metal arc welding- Principle, Equipments used and variables, Shielding gases and their effect on bead geometry, Mode of metal transfer and pulse MIG, Flux core arc welding and CO2 Welding, Applications of the process. |                   |
|  | <b>SUBMERGED ARC WELDING</b>                                                                                                                                                                                                  | <b>(06 Hours)</b> |
|  | Submerged arc welding- Principle, equipments used, welding parameters, SAW fluxes, classification, flux- wire combination, Multi wire, strip cladding and narrow gap welding Applications of the process.                     |                   |
|  | <b>RESISTANCE WELDING</b>                                                                                                                                                                                                     | <b>(04 Hours)</b> |
|  | Basic principle, brief introduction to spot, seam, projection and flash butt welding, welding variables, resistance welding equipments, heat balance, applications.                                                           |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                       |                   |

|           |                                                                                                                                                      |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                             |
| 1         | P. N. Rao, Manufacturing Technology-I, 4 <sup>th</sup> Edition, McGraw Hill Education, 2013                                                          |
| 2         | Howard B. Cary, Scott C. Helzer, Modern Welding Technology, Prentice Hall, 2005                                                                      |
| 3         | Baldev Raj, V. Shankar, A. K. Bhaduri, Welding Technology for Engineers, Narosa Publications, 2009                                                   |
| 4         | V. M. Radakrishnan, Welding Technology and Design, 2 <sup>nd</sup> Edition, New age internationals, 2005                                             |
| 5         | Ernest Paul DeGarmo, J. Temple Black, Ronald A. Kohser, Materials and Processes in Manufacturing, 8 <sup>th</sup> Edition, Prentice Hall India, 2007 |





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|---------------------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>DATA ANALYTICS IN SMART MANUFACTURING<br>(INSTITUTE ELECTIVE –II)<br>ME386 | Scheme | L | T | P | Credit |
|                                                                                                               |        | 3 | 0 | 0 | 03     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                           |
|-----|-------------------------------------------------------------------------------------------|
| CO1 | Explain the importance of data analytics in decision making.                              |
| CO2 | Illustrate the data types, distribution types and statistical parameters.                 |
| CO3 | Apply the descriptive analytics, and probability concepts in decision making.             |
| CO4 | Formulate sampling and estimation techniques, and test the hypothesis in decision making. |
| CO5 | Develop the regression models in decision making and clustering.                          |
| CO6 | Utilize the concept of Data Analytics in Smart Manufacturing.                             |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |
|    | INTRODUCTION TO BUSINESS ANALYTICS AND DESCRIPTIVE ANALYTICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | (08 Hours) |
|    | Business Analytics: The Science of Data Driven Decision Making, Descriptive Analytics, Predictive Analytics, Prescriptive Analytics, Descriptive, Predictive and Prescriptive Analytics Techniques, Big Data Analytics, Web and Social Media Analytics, Machine Learning Algorithms, Framework for Data-Driven Decision Making, Analytics Capability Building, Introduction to Descriptive Analytics, Data Types and Scales, Types of Data Measurement Scales, Population and Sample, Measures of Central Tendency, Percentile, Decile, and Quartile Measures of Variation, Measures of Shape – Skewness and Kurtosis, Data Visualization |            |
|    | PROBABILITY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | (06 Hours) |
|    | Probability Theory – Terminology, Fundamental Concepts in Probability – Axioms of Probability, Application of Simple Probability, Bayes' Theorem, Random Variables, Probability Density Functions and Cumulative, Distribution Function of a Continuous Random Variable, Binomial Distribution, Poisson Distribution, Geometric Distribution, Parameters of Continuous Distribution, Uniform Distribution, Exponential Distribution, Normal Distribution, Chi-Square Distribution, Student's t-Distribution, F- Distribution.                                                                                                             |            |
|    | SAMPLING AND ESTIMATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | (06 Hours) |



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|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Population Parameters and Sample Statistic, Sampling, Probabilistic Sampling, Non-Probability Sampling, Sampling Distribution, Central Limit Theorem, Sample Size Estimation for Mean of the Population, Estimation of Population Parameters, Methods of Moments, Estimation of Parameters Using Methods of Moments, Estimation of Parameters Using Maximum Likelihood Estimation, Confidence Interval for Population Mean, Population Proportion, Population Mean When Deviation is Unknown, Population Variance.                                                                                                                                                                            |                   |
|  | <b>HYPOTHESIS TESTING, ANALYSIS OF VARIANCE, CORRELATION ANALYSIS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>(06 Hours)</b> |
|  | Setting Up a Hypothesis Test, One-Tailed and Two Tailed Test, Hypothesis Testing for Population mean with known Variance: Z-test, Population Proportion: Z-test for Proportion, Variance: t-test, Paired Sample- t-Test, Comparing Two Populations: Two Sample Z- and t-test, Non-Parametric Tests: Chi-Square Tests, Analysis of Variance, Correlation.                                                                                                                                                                                                                                                                                                                                      |                   |
|  | <b>SIMPLE LINEAR REGRESSION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>(08 Hours)</b> |
|  | Simple Linear Regression, History of Regression-Francis Galton's Regression Model, Simple Linear Regression Model Building, Estimation of Parameters Using Ordinary Least Square, Interpretation of Simple Linear Regression Coefficients, Validation of the Simple Linear Regression Model, Outlier Analysis, Confidence Interval for Regression Coefficients, Confidence Interval for the Expected Value of Y for a Given X, Prediction Interval for the Value of Y for a Given X.                                                                                                                                                                                                          |                   |
|  | <b>MULTIPLE LINEAR REGRESSION AND CLUSTERING ANALYSIS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>(11 Hours)</b> |
|  | Introduction, Ordinary Least Squares Estimation for multiple linear regression, Multiple Linear regression model building, Part correlation and Regression model building, Interpretation of MLR coefficients-Partial Regression coefficient, Standardized regression coefficient, Introduction to clustering, Distance and Dissimilarity Measures used in clustering, Quality and Optimum number clusters; Clustering algorithms, Logistic Regression, Introduction to smart manufacturing, Key Drivers of Smart Manufacturing, Role of Additive Manufacturing technologies in smart manufacturing, Manufacturing of Smart Materials, 4D Printing, Artificial Intelligence in manufacturing. |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |

|           |                                                                                                                                                                                  |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                                                         |
| 1         | U. D. Kumar, Business Analytics: The Science of Data Driven Decision Making, Prentice Wiley, 2017                                                                                |
| 2         | S. C. Albright and W. L. Winston, Business Analytics: Data Analysis & Decision Making, Cengage Learning, 2015                                                                    |
| 3         | R. Bartlett, A Practitioner's Guide to Business Analytics: Using Data Analysis Tools to Improve your Organization's Decision Making and Strategy, McGraw Hill Professional, 2013 |
| 4         | R. N. Prasad and S. Acharya, Fundamentals of Business Analytics, Wiley India Pvt. Ltd., 2016                                                                                     |
| 5         | R. E. James, Business Analytics, Pearson Education, 2017.                                                                                                                        |





**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

|                                                                                                                     |               |          |          |          |               |
|---------------------------------------------------------------------------------------------------------------------|---------------|----------|----------|----------|---------------|
| <b>B.Tech. III (DoME) Semester – 6<br/>DESIGN FOR ADDITIVE MANUFACTURING<br/>(INSTITUTE ELECTIVE –II)<br/>ME388</b> | <b>Scheme</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>Credit</b> |
|                                                                                                                     |               | <b>3</b> | <b>0</b> | <b>0</b> | <b>03</b>     |

|                                                           |                                                                                                       |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>1. Course Outcomes (COs):</b>                          |                                                                                                       |
| <b>At the end of the course, students will be able to</b> |                                                                                                       |
| CO1                                                       | Identify the need of design for additive manufacturing.                                               |
| CO2                                                       | Apply design and manufacturing constraints and choose appropriate polymer or metal AM process.        |
| CO3                                                       | Design and analyse light weight structures for metal and polymer additive manufacturing technologies. |
| CO4                                                       | Analyze the complete AM process chain, from CAD part creation, to part production.                    |
| CO5                                                       | Build topology optimized parts for additive manufacturing.                                            |
| CO6                                                       | Examining AM from an economic point of view for both direct part production and tooling applications. |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |
|           | <b>INTRODUCTION TO DESIGN FOR ADDITIVE MANUFACTURING</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>(07 Hours)</b> |
|           | Introduction to Design for X, Need for Design for Additive Manufacturing (DfAM), CAD tools vs. DFAM tools, Requirements of DFAM methods, General Guidelines for Designing AM Parts, Design to avoid Anisotropy, The Economics of Additive Manufacturing, Design to Minimize Print Time, Design to Minimize Post- Processing, Take Advantage of Design Complexity, Function First, Materials Second, Use Topology Optimization or Lattice Structures. |                   |
|           | <b>COMPUTATIONAL TOOLS FOR DESIGN ANALYSIS AND OPTIMIZATION OF AM PARTS</b>                                                                                                                                                                                                                                                                                                                                                                          | <b>(08 Hours)</b> |
|           | Aims of Using Design Analysis for AM, Special Considerations for Analysis of AM Parts, Meshing, Boundary Conditions, Optimization, Topology Optimization, Parametric or Size Optimization, Build Process Simulation: Model Slicing, Contour Data Organization, Layer-by Layer Simulation, Hatching Strategies, Scan Pattern Simulation and Tool Path Generation.                                                                                     |                   |
|           | <b>DESIGN GUIDELINES FOR PART CONSOLIDATION</b>                                                                                                                                                                                                                                                                                                                                                                                                      | <b>(07 Hours)</b> |
|           | Design Guidelines for Part Consolidation: Design for Function, Material Considerations, Number of Fasteners, Knowledge of Conventional DFM/DFA, Assembly Considerations, Moving Parts.                                                                                                                                                                                                                                                               |                   |



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|  |                                                                                                                                                                                                                                                                                                                                                                                                            |                   |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>DESIGN FOR LEAST MATERIAL USAGE</b>                                                                                                                                                                                                                                                                                                                                                                     | <b>(08 Hours)</b> |
|  | Topology Optimization, Modelling of Design Space, Defining Design and Manufacturing Constraints, Performing Analysis for Weight Reduction, Maximize Stiffness, Minimize Displacement. Design for Improved Functionality, Multi scale design for Additive manufacturing, Mass customization, Biomimetic, Generative design, Design of multi-materials and functionally graded materials.                    |                   |
|  | <b>DESIGN FOR POLYMER AND METAL ADDITIVE MANUFACTURING</b>                                                                                                                                                                                                                                                                                                                                                 | <b>(07 Hours)</b> |
|  | Anisotropy, Wall Thicknesses, Overhangs, Support Material, Accuracy, Tolerances, Layer Thickness, Resolution, Print Orientation, Warpage, Over Sintering, Circular Profiles, Hollowing Parts, Holes, Fillets, Ribs, Threads, Font Sizes and Small Details. Powder Morphology, Powder Size Distribution, Material Characteristics, Designing to Minimize Stress Concentrations, Residual Stress, Shrinkage. |                   |
|  | <b>SOFTWARE AND CONTROLLER IN AM</b>                                                                                                                                                                                                                                                                                                                                                                       | <b>(08 Hours)</b> |
|  | Types of In-fill, Types of slicing, Software Integration (with Process, Slicing, etc), Control system (PLC and safety PLC, micro control/ Microcontroller, Micro-processor control), CAD Software and Controller Interfacing, CURA Software, Relevant G/M Codes, Standard firmware (Merlin Software, etc), In-process Monitoring, Calibration.                                                             |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                    |                   |

|           |                                                                                                                                                                   |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                                          |
| 1         | Ian Gibson, David Rosen, and Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Springer, 2015 |
| 2         | Diegel, Olaf, Axel Nordin, and Damien Motte, A Practical Guide to Design for Additive Manufacturing, Springer, 2020                                               |
| 3         | Rupinder Singh J. Paulo Davim, Additive Manufacturing - Applications and Innovations, CRC Press Taylor & Francis Group, 2019                                      |
| 4         | L. Jyothish Kumar, Pulak M. Pandey, David Ian Wimpenny, 3D Printing and Additive Manufacturing Technologies, Springer, 2019                                       |
| 5         | Laroux K, Gillespie, Design for Advanced Manufacturing: Technologies and Process, McGrawHill, 2017                                                                |





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|                                                                                                             |        |   |   |   |        |
|-------------------------------------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br><b>MACHINERY FAULT DIAGNOSIS AND SIGNAL PROCESSING (HONORS)</b><br>MEHD3 | Scheme | L | T | P | Credit |
|                                                                                                             |        | 3 | 1 | 0 | 04     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                                            |
|-----|----------------------------------------------------------------------------|
| CO1 | Choose condition monitoring methods for fault diagnosis in machines.       |
| CO2 | Study the vibration signals from rotating machines.                        |
| CO3 | Illustrate the vibration signals from reciprocating machines.              |
| CO4 | Analyse the signals from rotating and reciprocating machines.              |
| CO5 | Apply fault detection techniques for fault diagnosis in rotating machines. |
| CO6 | Show the instrumentation in fault diagnosis of machines.                   |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
|           | <b>INTRODUCTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>(20 Hours)</b> |
|           | <p>Introduction to condition based monitoring, fault diagnosis and prognosis, machine learning in fault diagnosis.</p> <p>Condition Monitoring Techniques: Vibration and noise monitoring, wear debris and oil analysis, thermography, acoustic emission, ultrasonic, Eddy current.</p> <p>Vibration Analysis: Basics of vibration, free and forced response, vibration control, random vibration, statistical parameters i.e. RMS value, peak value, crest factor, kurtosis, standard deviation of vibration signals.</p> <p>Vibration Signals from Rotating Machines: Signal classification, signals generated by rotating machines, low shaft orders and subharmonics, vibrations from gears, rolling element bearings and electrical machines.</p> <p>Vibration Signals from Reciprocating Machines: Signals generated by reciprocating machines time-frequency diagrams, torsional vibrations.</p> |                   |
|           | <b>SIGNAL PROCESSING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>(10 Hours)</b> |



## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

### Department of Mechanical Engineering

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|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Sample rate and aliasing, filtering, time domain signal analysis, frequency domain signal analysis, non-stationary signal analysis, Fourier series, Fast Fourier Transform, wavelet transform, Hilbert transform, modulation and sidebands, orbit and order analysis, cepstrum analysis.                                                      |                   |
|  | <b>FAULTS IN ROTATING MACHINES</b>                                                                                                                                                                                                                                                                                                            | <b>(15 Hours)</b> |
|  | Faults in Rotating Machines: Unbalance, misalignment, crack, spalling, loosening, fault in electrical machines. Failure analysis of rotating machines, bearings and gears, fans, blowers, pumps, IC Engines.<br><br>Instrumentation: Data recording, data acquisition, errors in measurements, transducers, accelerometer, sound level meter. |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                       |                   |

|           |                                                                                                                       |
|-----------|-----------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                              |
| 1         | A. R. Mohanty, Machinery Condition Monitoring: Principles and Practices, CRC Press, 2014.                             |
| 2         | J. S. Rao, Vibration Condition Monitoring, Narosa Publishing House, 2 <sup>nd</sup> Edition, 2000.                    |
| 3         | K. K. Choudary, Instrumentation, Measurement and Analysis, Tata McGraw Hill, 2012.                                    |
| 4         | R. B. Randall, Vibration-based Condition Monitoring: Industrial, Automotive and Aerospace Applications, Wiley, 2021.  |
| 5         | B. K. N. Rao and A. Davies, Handbook of Condition Monitoring: Techniques and Methodology, Springer Netherlands, 1998. |





**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

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|                                                                                                              |               |          |          |          |               |
|--------------------------------------------------------------------------------------------------------------|---------------|----------|----------|----------|---------------|
| <b>B.Tech. III (DoME) Semester – 6<br/>DESIGN AND OPTIMIZATION OF THERMAL<br/>SYSTEMS (HONORS)<br/>MEHT3</b> | <b>Scheme</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>Credit</b> |
|                                                                                                              |               | <b>3</b> | <b>1</b> | <b>0</b> | <b>04</b>     |

**1. Course Outcomes (COs):****At the end of the course, students will be able to**

|     |                                                                                                                     |
|-----|---------------------------------------------------------------------------------------------------------------------|
| CO1 | Understand the simulation of thermal systems with more than one component involving linear or non-linear equations. |
| CO2 | Apply various methods for both exact and best fits to fit the data.                                                 |
| CO3 | Analyse mathematical formulation of optimization problems as applicable to thermal systems.                         |
| CO4 | Evaluate non-linear optimization problems with both equality and inequality constraints using Lagrange multipliers. |
| CO5 | Choose Search methods for solving unconstrained and constrained optimization problems.                              |
| CO6 | Utilize stochastic optimization techniques to thermal system design.                                                |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                               |                   |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                                                                                                                                                                               |                   |
|           | <b>DESIGN OF THERMAL SYSTEMS</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>(08 Hours)</b> |
|           | Introduction to thermal systems, Design analysis of thermal systems through the flow chart, Identifying the need, Market research, Procedure of Thermal Analysis and Design, Constraints in Design, Workable system and optimum system, Optimum Design.                                                                                                                                                                       |                   |
|           | <b>THERMAL SYSTEMS SIMULATION</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>(10 Hours)</b> |
|           | Introduction and uses of simulations, Classes of simulation, Information flow diagrams, Techniques for thermal system simulation: Successive substitution method (Example of heater, Fans, Duct Systems etc.), Newton Raphson method for single and multiple unknowns (Examples of Steam boiler, Feed water heater etc.), System of linear equations: Gauss-Seidal method (Examples from Oil cooler, Chemical reactors etc.). |                   |
|           | <b>REGRESSION AND CURVE FITTING FOR THERMAL SYSTEMS SIMULATION</b>                                                                                                                                                                                                                                                                                                                                                            | <b>(12 Hours)</b> |
|           | Need for regression in thermal systems simulation and optimization, Concept of best fit and exact fit, Exact fit and its types: Lagrange interpolation (Example of Heat Transfer from wall), Newton's divided difference (Example of Viscosity as function of temperature), Strategies for best fit, Least Square Regression (Example of Turbulent flow in a pipe, cooling of ball bearing                                    |                   |



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|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | etc.), Linear regression with one and more unknowns, Non-linear least squares: Gauss-Newton Algorithm (Example of Lumped capacitance method etc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |
|  | <b>OPTIMIZATION OF THERMAL SYSTEMS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>(15 Hours)</b> |
|  | <p>Formulation of optimization problems (Example of Refinery plant), Representation of optimization problems, Optimization techniques: Calculus methods and search methods, Ex: Solar collector, Steam power plant, Calculus method: Lagrange multiplier (Example of Shell and Tube Heat Exchanger, Constrained and unconstrained optimization problems (Examples on energy systems), Tests for maxima/minima (Examples of Solar water heater problems, Flow in pipe network etc.), Handling in equality constraints, Kuhn-Tucker condition</p> <p>Search methods: Unimodal function, Exhaustive search method (Example of Solar water heater problem), Dichotomous search method, Fibonacci series search method (Example of Water heater storage), Golden section method (Example of Heat dissipation problem), Multivariable unconstrained problem.</p> <p>Linear programming and dynamic programming (Example of Refining plant, Steam turbine etc.)</p> <p>Non-traditional optimization techniques: Genetic algorithms, Simulated annealing (Example of Cylindrical storage heater)</p> |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |

|           |                                                                                                                                                   |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                          |
| 1         | Essentials of Thermal System Design and Optimization, Prof. C. Balaji, Ane Books, New Delhi in India and CRC Press in the rest of the world, 2018 |
| 2         | Design and optimization of thermal systems, Y. Jaluria, CRC Press, 3rd edition, 2020.                                                             |
| 3         | Engineering Design and Optimization of Thermo-fluid Systems, David S. K. Ting et al. Wiley, 2021                                                  |
| 4         | Thermal Energy Systems: Design, Computational Techniques, and Applications" Arijit Kundu et al., CRC Press, 2023                                  |
| 5         | Introduction to optimum design, J. S. Arora, Academic Press, 5th edition, 2024.                                                                   |





# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering  
B.Tech. –III, Mechanical Engineering (As per NEP)

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|-----------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>MICRO AND NANO MANUFACTURING (HONORS)<br>MEHM3 | Scheme | L | T | P | Credit |
|                                                                                   |        | 3 | 1 | 0 | 04     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                                      |
|-----|----------------------------------------------------------------------------------------------------------------------|
| CO1 | Classify and describe micro and nano manufacturing processes based on applications                                   |
| CO2 | Explain and select suitable micro machining/ micro forming/ MEMS processes based on given parameters and constraints |
| CO3 | Show and select suitable MEMS/NEMS technique for identified application.                                             |
| CO4 | Distinguish between the requirements for micro and nano manufacturing processes                                      |
| CO5 | Recommend a suitable nano- manufacturing process for a given application.                                            |
| CO6 | Propose suitable metrological technique for measuring micro and nano features.                                       |

|    |                                                                                                                                                                                                                                                |            |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                       |            |
|    | INTRODUCTION                                                                                                                                                                                                                                   | (03 Hours) |
|    | Introduction to miniaturization and its needs, scaling laws, micro products and design considerations, classification, selection of micro machining processes, applications.                                                                   |            |
|    | MICRO MACHINING PROCESSES                                                                                                                                                                                                                      | (14 Hours) |
|    | Evolution and Principle of micromachining, micro turning, micro milling, micro grinding, ultrasonic micro machining, abrasive jet micro machining, micro electro discharge machining, micro electro chemical machining, laser micro machining. |            |
|    | MICRO FORMING PROCESSES                                                                                                                                                                                                                        | (09 Hours) |
|    | Micro scale plastic deformation, size effect, micro deep drawing, micro extrusion, micro punching, micro blanking, micro fabrication using bulk metallic glasses, flow induced defects.                                                        |            |
|    | MEMS AND NEMS TECHNIQUES                                                                                                                                                                                                                       | (07 Hours) |
|    | Classification, principle and working, photo lithography, chemical etching, LIGA, materials Non-traditional optimization techniques: Genetic algorithms, Simulated annealing (Example of Cylindrical storage heater)                           |            |
|    | INTRODUCTION TO NANO MANUFACTURING                                                                                                                                                                                                             | (08 Hours) |



# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

## Department of Mechanical Engineering

### B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                                                                                                                                        |                   |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Transition from nano technology to nano manufacturing; diamond turn machining; nano joining, nano soldering, nano welding, mechanical bonding, fastening; chemical vapor deposition, scanning tunnelling microscopy, nano lithography                                                                  |                   |
|  | <b>ABRASIVE BASED NANO FINISHING PROCESSES</b>                                                                                                                                                                                                                                                         | <b>(04 Hours)</b> |
|  | Abrasive flow finishing, chemo-mechanical polishing, magnetic abrasive finishing, magnetorheological finishing, magnetorheological abrasive flow finishing, magnetic float polishing, hybrid nanofinishing: chemo-mechanical magnetorheological finishing, electrochemical magnetic abrasive finishing |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                                                |                   |

|                             |                                                                                                 |
|-----------------------------|-------------------------------------------------------------------------------------------------|
| <b>3. Books Recommended</b> |                                                                                                 |
| 1                           | Kei Cheng & Dehong Heo, Micro Cutting: Fundamentals and Applications, John Willey & Sons, 2013. |
| 2                           | V K Jain, Micromanufacturing Processes, CRC Press, 2013.                                        |
| 3                           | Mark J. Jackson, Micromachining with Nanostructured Cutting Tools, Springer, 2013.              |
| 4                           | N. Maluf and K. Williams, Introduction to MEMS Engineering, 2nd edition, Artechhouse, 2004.     |
| 5                           | V K Jain, Nanofinishing Science and Technology, CRC Press, 2017.                                |





**Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat**

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|-------------------------------------------------------------------------------------|---------------|----------|----------|----------|---------------|
| <b>B.Tech. III (DoME) Semester – 6<br/>HYDRO AND WIND ENERGY (HONORS)<br/>MEHE3</b> | <b>Scheme</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>Credit</b> |
|                                                                                     |               | <b>3</b> | <b>1</b> | <b>0</b> | <b>04</b>     |

**1. Course Outcomes (COs):**

At the end of the course, students will be able to

|     |                                                                                                                                                                   |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | Introduce the fundamental principles of hydropower, including the conversion of potential energy in water into mechanical and electrical energy.                  |
| CO2 | Explore the various auxiliary systems and supporting structures essential for the operation, safety, and efficiency of the Hydro power plant.                     |
| CO3 | Evaluate the different types of hydraulic turbines and understand their operating mechanisms, performance, design differences, and applications.                  |
| CO4 | Understand of the fundamental principles, technologies, and applications of wind energy as a renewable power source.                                              |
| CO5 | Comprehend the fundamental concepts of wind energy conversion, including the basic principles of harnessing wind energy and converting it into electrical energy. |
| CO6 | Assess theoretical and practical performance of wind turbines including optimal tip speed ratio requirement                                                       |

|           |                                                                                                                                                                                                                                                                            |                   |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>2.</b> | <b>Syllabus</b>                                                                                                                                                                                                                                                            |                   |
|           | <b>INTRODUCTION TO HYDROPOWER</b>                                                                                                                                                                                                                                          | <b>(08 Hours)</b> |
|           | Introduction, Water Cycle in Nature, Application of Hydro-Electric power plants, Status of Hydro power worldwide, Advantages and disadvantages, Introduction to small Hydro Power Plants, Selection of site for Hydropower plant, Classification, Operational terminology. |                   |
|           | <b>HYDROPOWER ELEMENTS</b>                                                                                                                                                                                                                                                 | <b>(08 Hours)</b> |
|           | Important Parts of Hydropower Station: Turbine, Electric Generator, Transformer and Power House, Structural parts: Dam and Spillway, Surge Chambers, Stilling Basins, Penstock and Spiral Casing, Tailrace, Pressure Pipes, Caverns, auxiliary parts.                      |                   |
|           | <b>HYDRAULIC TURBINES</b>                                                                                                                                                                                                                                                  | <b>(08 Hours)</b> |
|           | Hydraulic Turbines: Classification of Hydraulic Turbines, Impulse and Reaction Hydraulic Turbines, Theory of Hydro Turbines, Cost of Hydro power, Hydrology: Cyle, Measurement of run-off, Hydro graph and flow duration curve.                                            |                   |



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|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | <b>INTRODUCTION TO WIND ENERGY</b>                                                                                                                                                                                                                                       | <b>(08 Hours)</b> |
|  | Introduction, History of wind energy, Current status and future prospects, Wind energy in India, Advantages and Disadvantages of Wind Energy, Environment aspects of Wind Energy, Sources of Wind, Wind availability and measurement.                                    |                   |
|  | <b>WIND ENERGY CONVERSION SYSTEMS (WECS)</b>                                                                                                                                                                                                                             | <b>(08 Hours)</b> |
|  | Principle of Wind Energy Conversion, Wind Power, Basic Components of Wind Energy Conversion System, Advantages and Disadvantages of WECS, Considerations for Selection of Site for WECS.                                                                                 |                   |
|  | <b>WIND TURBINES</b>                                                                                                                                                                                                                                                     | <b>(05 Hours)</b> |
|  | Basic Terminologies and definitions, Power available in the wind, Horizontal and Vertical axis wind turbine, Wind turbine power and torque characteristics, Tip speed ratio, Optimal tip speed ratio, Wind speed prediction and forecasting, Betz limit, Govt. Policies. |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                  |                   |

|           |                                                                                                                                 |
|-----------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                        |
| 1         | Twidell, J., & Weir, T. Renewable Energy Resources. Routledge, 2015                                                             |
| 2         | Spera D.A., Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering, 2009                                     |
| 3         | Er. R. K. Rajput, Non-Conventional Energy Sources and Utilisation, S. Chand Publication, 2014                                   |
| 4         | Dr. R. K. Singhal, Non-Conventional Energy Resources, S.K. Kataria and Sons, 2013                                               |
| 5         | Wagner, Hermann-Josef, Mathur, Jyotirmay, Introduction to Hydro Energy Systems Basics, Technology and Operation, Springer, 2011 |





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|                                                                              |        |   |   |   |        |
|------------------------------------------------------------------------------|--------|---|---|---|--------|
| B.Tech. III (DoME) Semester – 6<br>MANUFACTURING PROCESSES (MINORS)<br>MEM33 | Scheme | L | T | P | Credit |
|                                                                              |        | 3 | 1 | 0 | 04     |

## 1. Course Outcomes (COs):

At the end of the course, students will be able to

|     |                                                                                                     |
|-----|-----------------------------------------------------------------------------------------------------|
| CO1 | Classify and explain manufacturing processes.                                                       |
| CO2 | Outline the working principles of various metal casting processes.                                  |
| CO3 | Explain the principles of material removal, bulk deformation of metals, and sheet metal operations. |
| CO4 | Compare various joining processes and explain their defects & prevention.                           |
| CO5 | Select relevant the manufacturing processes for a given workpieces to create desired feature.       |
| CO6 | Show need of the heat treatment and surface modification processes.                                 |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                |            |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 2. | Syllabus                                                                                                                                                                                                                                                                                                                                                                                                                       |            |
|    | INTRODUCTION                                                                                                                                                                                                                                                                                                                                                                                                                   | (08 Hours) |
|    | Introduction to manufacturing, Fundamental approaches of manufacturing, Classification of manufacturing processes, Specific advantages and limitation, Materials in manufacturing, Selection of manufacturing processes, Application of manufacturing processes, Effect of manufacturing processes on properties of metals. Introduction of computer-integrated manufacturing systems, micro & nano-manufacturing, automation. |            |
|    | METAL CASTING                                                                                                                                                                                                                                                                                                                                                                                                                  | (09 Hours) |
|    | Introduction of Metal Casting & Suitability, Steps of casting processes, Pattern allowances, Sand Moulding, Core & Core Prints, Gating System, Cleaning of casting, Casting defects & their prevention, Shell moulding, Investment and permanent mould casting.                                                                                                                                                                |            |
|    | METAL FORMING                                                                                                                                                                                                                                                                                                                                                                                                                  | (08 Hours) |
|    | Hot and cold working, Deformation processes and sheet metal operations.                                                                                                                                                                                                                                                                                                                                                        |            |
|    | MATERIAL REMOVAL                                                                                                                                                                                                                                                                                                                                                                                                               | (14 Hours) |



## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Mechanical Engineering

B.Tech. –III, Mechanical Engineering (As per NEP)

|  |                                                                                                                                                                                                                                                                          |                   |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|  | Introduction to Machining, Mechanism of the metal cutting, Chip Formation, Types of chips; Cutting tool technology: tool geometry, failure and tool life, tool materials; Introduction of different conventional and nonconventional machining processes and equipments. |                   |
|  | <b>JOINING OF METALS</b>                                                                                                                                                                                                                                                 | <b>(06 Hours)</b> |
|  | Fundamentals of joining of metals, Joining processes; Weldability and welding defects.                                                                                                                                                                                   |                   |
|  | <b>(Total Contact Time: = 45 Hours)</b>                                                                                                                                                                                                                                  |                   |

|           |                                                                                                                                                         |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3.</b> | <b>Books Recommended</b>                                                                                                                                |
| 1         | S. Kalpakjian and S. R. Illinois, Manufacturing Engineering and Technology; 6 <sup>th</sup> Edition, Pearson Prentice Hall, New Jersey, 2010.           |
| 2         | M.P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems; 3 <sup>rd</sup> Edition, Wiley India Pvt. Ltd., New Delhi, 2012. |
| 3         | P. N. Rao, Manufacturing Technology-I, 4th Edition, Mc Graw Hill Education, 2013.                                                                       |
| 4         | P. N. Rao, Manufacturing Technology-II, 4th Edition, Mc Graw Hill Education, 2013.                                                                      |
| 5         | Ernest Paul DeGarmo, J. Temple Black, Ronald A. Kohser, Materials and Processes in Manufacturing, 8 <sup>th</sup> Edition, Prentice Hall India, 2007.   |

