# ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
## (Autonomous)
## Course structure for Four Year Regular B.Tech. Degree Program
## (Effective for the batches admitted from 2019-20)
## MECHANICAL ENGINEERING (ME)

**III B. Tech – I Semester**

| S.No | Category | Course Code | Course Title | Contact Hours per week | | | Credits | Scheme of Examination (Max. Marks) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | CIE | SEE | Total |
| **THEORY** | | | | | | | | | | |
| 1 | PC | 19APC0325 | Dynamics of Machines | 3 | 0 | 0 | 3 | 30 | 70 | 100 |
| 2 | PC | 19APC0310 | Thermal Engineering – I | 3 | 0 | 0 | 3 | 30 | 70 | 100 |
| 3 | PC | 19APC0316 | Design of Machine Members - 1 | 3 | 0 | 0 | 3 | 30 | 70 | 100 |
| 4 | PC | 19APC0324 | Machine Tools | 3 | 0 | 0 | 3 | 30 | 70 | 100 |
| 5 | PE | | **Professional Elective I** | 3 | 0 | 0 | 3 | 30 | 70 | 100 |
| | | 19APE0304 | Nano Technology | | | | | | | |
| | | 19APE0305 | Composite materials | | | | | | | |
| | | 19APE0306 | Renewable Energy Technologies | | | | | | | |
| 6 | OE | | **Open Elective I (Inter disciplinary)** | 3 | 0 | 0 | 3 | 30 | 70 | 100 |
| | | 19AHSMB01 | Managerial Economics and Financial Analysis | | | | | | | |
| | | 19APE0501 | Artificial Intelligence | | | | | | | |
| | | 19APE0416 | Sensor Networks | | | | | | | |
| 7 | MC | 19AMC9902 | Constitution of India | 2 | 0 | 0 | 0 | 30 | - | 30 |
| **PRACTICAL** | | | | | | | | | | |
| 8 | PR | 19APR0302 | Socially Relevant Projects (15 Hrs /Sem) | 0 | 0 | 0 | 0.5 | 50 | - | 50 |
| 9 | PC | 19APC0311 | Thermal Engineering Lab | 0 | 0 | 2 | 1 | 30 | 70 | 100 |
| 10 | PC | 19APC0305 | Machine Tools Lab | 0 | 0 | 2 | 1 | 30 | 70 | 100 |
| 11 | PC | 19APC0315 | Computer Aided Drafting Lab | 0 | 0 | 2 | 1 | 30 | 70 | 100 |
| | | | **Total** | **18** | **0** | **6** | **21.5** | **350** | **630** | **980** |

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APC0325 | Dynamics of Machines | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 To understand the application of friction in pivots, collars, clutches, brakes, and dynamometers, and also to solve the numerical problems

CO: 2 To understand gyroscopic effect on Aeroplane, ship, four wheel and two-wheel vehicles. To design a flywheel for reciprocating engine and punching press.

CO: 3 To understand the working of various types of governors and to analyze the forces acting on them. To solve numerical problems on balancing of rotating masses

CO: 4 To understand that effect of primary and secondary balancing of reciprocating masses in locomotive engines, V-engine, inline engines and Radial engines

CO: 5 To understand the concept of different types of vibratory systems and to perform simple calculations of vibration systems

**UNIT I**

**Friction:**
Types of friction, inclined plane, screw friction, screw jack, Journal bearing, concept of uniform pressure and uniform wear, pivot bearings – flat, conical and trapezoidal, flat collar bearings, friction clutches – flat, conical and centrifugal, Brakes – Block or Shoe Brake, Band Brake, Band and Block Brake, Internal Expanding Shoe Brake, Effect of Braking on vehicle, general description and method of operation of Dynamometers.

**UNIT II**

**Gyroscope:**
Effect of gyroscopic couple on the stability of moving Aeroplane, ship, motor car and motor cycle.

**Fluctuation of Energy:**
Turning moment diagrams for steam engine, IC Engine and multi cylinder engine, coefficient of Fluctuation of energy, coefficient of Fluctuation of speed, design of Fly wheels for reciprocating engines, design of Fly wheels for punching machines.

**UNIT III**

**Governors:**
Watt governor, dead weight governor – Porter and Proell governors. Spring loaded governors – Hartnell, Hartung and Wilson Hartnell governors. Sensitiveness, isochronism and hunting. Effort and power of a governor.

**Balancing of rotating masses**:
Single in single plane, multiple masses in single plane, multiple masses indifferent planes.

**UNIT IV**

**Balancing of Reciprocating masses:**
Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Balancing of Locomotives, Effects of Partial Balancing in Locomotives, Balancing of Inline Engines, V-engines, and Radial Engines. Unbalanced forces and couples for primary and secondary balancing.

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**UNIT V**

**Vibrations:**

Free Longitudinal Vibrations, Inertia Effect of the Mass of Spring, Damped Vibrations, Forced Vibrations, Forced-damped Vibrations, Transverse Vibrations of Shaft due to Single Load, uniformly distributed Load and Several Loads, Dunkerly‟s method, Raleigh‟s method, Whirling of Shafts, Free Torsional Vibrations in Single Rotor, Two-rotor and Three-rotor Systems, Inertia Effect of Mass of Shaft, Torsionally Equivalent Shaft.

**Text Books:**

1. Theory of Machines, S.S. Rattan, Tata McGraw Hill.
2. Kinematics and Dynamics of Machinery R.L. Norton, Tata McGraw Hill.

**Reference Books:**

1. Theory of Machines, Thomas Bevan, Pearson.
2. The theory of Machines, Ballaney, Kanna Publishers
3. Theory of Machines and Mechanisms of Shigley et.al. Oxford International.
4. Theory of Machines, Kinematics and Dynamics sadhu gingh, Pearson
5. A Text Book of Theory of Machines. R. K. Bansal, Laxmi Publications
6. Theory of Mechanisms and Machines, Jagadish Lal, Metropolitan company pvt. Ltd

| List of COs | PO no. and keyword | Competency | Performance Indicator |
|---|---|---|---|
| CO 1 | PO 1: Engineering knowledge | 1.4 | 1.4.1 |
| CO 2 | PO 2: Problem analysis | 2.1 | 2.1.3 |
| CO 3 | PO 4: Conduct investigations of complex problems | 4.1 | 4.1.2 |
| CO 4 | PO 2: Problem analysis | 2.1 | 2.1.2 |
| CO 5 | PO 1: Engineering knowledge | 1.4 | 1.4.1 |

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| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APC0310 | Thermal Engineering – I | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 To student can know working of both S.I and C.I engines with the help of indicator diagrams.
CO: 2 Student can understand the fuel supply systems, cooling, lubrication and ignition systems
CO: 3 Student can understand the flame propagation inside the cylinder, stages of combustion in S.I and C.I engines
CO: 4 To familiar with indicated power, brake power and friction power and their methods of measurement
CO: 5 The working of reciprocating and rotary air compressors. Student can calculate work done by single and multistage reciprocating air compressors.

**UNIT I**

I.C. ENGINES: Definition of Engine And Heat Engine, I.C Engine Classification – Parts of I.C. Engines, Working of I.C. Engines, Two Stroke & Four Stroke I.C. Engines SI & CI Engines, Valve and Port Timing Diagrams.

**UNIT II**

Fuel System: S.I. Engine: Fuel Supply Systems, carburetor types Air Filters, Mechanical and Electrical Fuel Pump – Filters– Gasoline Injection Systems.. Cooling & Lubrication Systems: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo Siphon, Water And Forced Circulation System; Lubrication Systems-Flash, Pressurized and Mist Lubrication. Ignition System: Function Of An Ignition System, Battery coil Ignition System, Magneto Coil Ignition System, Electronic Ignition System using Contact Breaker, Electronic Ignition using Contact Triggers – Spark Advance And Retard Mechanism.

**UNIT III**

Fuels and Combustion: S I engine: Normal Combustion and Abnormal Combustion – Importance of Flame Speed and Effect of Engine Variables – Type of Abnormal Combustion, Pre-Ignition and Knocking (Explanation) – Fuel Requirements and Fuel Rating, Anti Knock Additives, Combustion Chambers. C.I. Engines: Stages Of Combustion – Delay Period And Its Importance – Effect Of Engine Variables – Diesel Knock– Combustion Chambers (DI And IDI), Fuel Requirements And Fuel Rating.

**UNIT IV**

Testing and Performance : Parameters of Performance - Measurement of Cylinder Pressure, Fuel Consumption, Air Intake, Exhaust Gas Composition, Brake Power – Determination of Frictional Losses And Indicated Power – Performance Test – Heat Balance Sheet and Chart.

**UNIT V**

Air Compressors: Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors.

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GAS TURBINES: Simple Gas Turbine Plant – Ideal Cycle, Essential Components – Parameters of Performance. jet propulsion: Principle of Operation – Classification of Jet Propulsive Engines – Working Principles with Schematic Diagrams and Representation on T-S Diagram

**Text Books:**

1. Internal Combustion Engines / V. Ganesan- TMH, 4th Edition,2012
2. Thermal Engineering / Rajput / Lakshmi Publications, 9th Edition,2013

**Reference Books:**

1. I.C. Engines fundamentals, Heywood, McGrawHIll, 1st Edition,2011
2. IC Engines – Mathur& Sharma – DhanpathRai& Sons, ,2010
3. Engineering fundamentals of IC Engines – Pulkrabek, Pearson, PHI, 2nd Edition,2009
4. Thermal Engineering, Rudramoorthy – TMH, 10th Edition,2010
5. Thermodynamics & Heat Engines, B. Yadav, Central publishing house., Allahabad, 2002
6. Thermal Engineering – R.S. Khurmi & J.K.Gupta – S.Chand, 15th Edition,2012

| List of COs | PO no. and keyword | Competency Indicator | Performance Indicator |
|---|---|---|---|
| CO: 1 | PO 1: Engineering knowledge | 1.3 | 1.3.1 |
| CO: 2 | PO 2: Problem analysis | 2.1 | 2.1.3 |
| CO: 3 | PO 4: Conduct investigations of complex problems | 4.1 | 4.1.2 |
| CO: 4 | PO 2: Problem analysis | 2.1 | 2.1.2 |
| CO: 5 | PO 1: Engineering knowledge: | 2.6 | 2.6.3 |

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| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APC0316 | Design of Machine Members - 1 | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 To apply design procedures using theories of failure for different elements
CO: 2 Able to design simple components under cyclic loading using Goodman's and Soderberg's criterions
CO: 3 Able to design riveted joints with different configuration, boiler shell joint design and eccentric loading design of riveted joints
CO: 4 To design cotter joint, knuckle joint and shafts
CO: 5 To design various rigid and flexible shaft couplings

**UNIT I**

INTRODUCTION: General considerations of design, design process. Selection of Engineering Materials - properties –Manufacturing considerations in the design. BIS codes of materials, preferred numbers and interchangeability. STRESSES IN MACHINE MEMBERS: Simple stresses – Combined stresses – Torsional and bending Stresses – impact stresses – stress -strain relation – Theories of failure – factor of safety.

**UNIT II**

DESIGN FOR FLUCTUATING LOADS: Stress concentration –notch sensitivity – Design for fluctuating stresses – Estimation of Endurance strength – Goodman's line – Soderberg's line. Design of components for finite and infinite life.

**UNIT III**

DESIGN OF RIVETED JOINTS: Types of riveted joints, design of riveted joints. Boiler shell riveting design and eccentric loading design of riveted joints. DESIGN OF BOLTED JOINTS: Forms of Screw threads. Stresses in Screw fasteners. Design of bolts with pre-stresses, Design of bolted joints under eccentric loading, Bolts of uniform strength.

**UNIT IV**

DESIGN OF COTTERS AND KNUCKLE JOINTS: Design of Cotter joints: spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints DESIGN OF SHAFTS: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads.

**UNIT V**

DESIGN OF KEYS AND COUPLINGS: Design of Rigid couplings: Muff, Split muff and Flange couplings- Design of flexible couplings.

**Text Books:**

1. Machine Design, Schaum'sseries, TMH Publishers, NewDelhi, 1st edition, 2011
2. Machine Design, R.S. Kurmi and J.K. Gupta, S.Chand Publishers, NewDelhi

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**Reference Books:**

1. Machine Design, R.K.Jain, KhannaPublishaers,New Delhi.
2. Machine Design, SadhuSingh, KhannaPublishers, NewDelhi
3. Mechanical Engineering Design, JosephE.Shigely,TMH Publishers,NewDelhi, 9th edition, 2011 R
4. Design of Machine Elements, M.F. Spotts, PHIPublishers, NewDelhi.
5. Machine Design, Pandya and Shah, CharotarPublishers,Anand, 17th edition, 2009
6. Machine Design, R.L. Norton, Tata McGrawHillPublishers, 2nd edition, 2002
7. Machine Design by Groover – CBS Publications, 5th edition, 2012.
8. Machine Design Data Book, V B Bhandari, McGraw Hill,2014

| COs | PO No. and keyword | Competency Indicator | Performance Indicator |
|---|---|---|---|
| CO1 | PO 5: Modern tool usage | 5.2 | 5.2.2 |
| CO2 | PO 1: Engineering knowledge | 1.2 | 1.2.2 |
| CO3 | PO 5: Modern tool usage | 5.2 | 5.2.2 |
| CO4 | PO 5: Modern tool usage | 5.2 | 5.2.2 |
| CO5 | PO 1: Engineering knowledge<br>PO 7: Environment and sustainability | 1.6<br>7.2 | 1.3.1<br>7.2.1 |

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APC0324 | Machine Tools | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 To understand the basic concepts of the philosophy of metal cutting and the mechanism of chip formation
CO: 2 To understand the basic concepts of turning.
CO: 3 To understand the basic principle of drilling, shaping and planning operation, parts of the drilling
CO: 4 To able to understand the principle of milling, grinding, Lapping, Honing and Broaching operation
CO: 5 Tto understand the design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping

**UNIT I**

Elementary treatment of metal cutting theory – Elements of cutting process – Geometry of single point tool and angles, chip formation and types of chips – built up edge and its effects, chip breakers. Mechanics of orthogonal cutting –Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, heat generation, tool life, coolants, machinability –economics of machining. cutting Tool materials and cutting fluids –types and characteristics.

**UNIT II**

Engine lathe – Principle of working- specification of lathe – types of lathes – work holders and tool holders –Taper turning, thread turning and attachments for Lathes.Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – Single spindle and multi-spindle automatic lathes– tool layout and cam design

**UNIT III**

Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring tools – machining time calculation. Shaping, Slotting and Planning machines –Principles of working – Principal parts – specification, classification, Operations performed. Machining time calculations.

**UNIT IV**

Milling machine – Principles of working – specifications – classifications of milling machines – Principal features – machining operations, Types and geometry of milling cutters– methods of indexing – Accessories to milling machines. Grinding machine –Theory of grinding –

classification– cylindrical and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines – Grinding wheel: Different types of abrasives – bonds, specification and selection of a grinding wheel. Static and dynamic balancing of a wheel Truing and Dressing of wheels. Lapping, Honing and Broaching machines – comparison of grinding, lapping and honing. machining time calculations.

**UNIT V**

Principles of design of Jigs and fixtures and uses, 3-2-1 Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices, Typical examples of jigs and fixtures Unit built machine tools – multispindle heads. power units-principal of working types of UBMTS, characterization, applications.

**Text Books:**

1. Workshop Technology – Vol II, B.S.RaghuVamshi, Dhanpat Rai & Co, 10th edition, 2013
2. Production Technology by R.K. Jain and S.C. Gupta, Khanna Publishers, 17th edition, 2012

**Reference Books:**

1. Manufacturing Technology-Kalpakzian- Pearson
2. Metal cutting Principles by Milton C.Shaw, oxford Second Edn, 2nd edition, 2012
3. Production Technology by H.M.T. (Hindustan Machine Tools),TMH, 1st edition, 2001
4. Production Technology by K.L.Narayana, IK International Pub.
5. Machining and machine tools by AB. Chattopadyay, WileyEdn,2013
6. Unconventional Machining process by V.K.Jain, Allied Pub.
7. Manufacturing technology Vol II by P.N. Rao, Tata McGraw Hill, 4th edition, 2013

| COs | PO No. and keyword | Competency Indicator | Performance Indicator |
|---|---|---|---|
| CO1 | PO 5: Modern tool usage | 5.2 | 5.2.2 |
| CO2 | PO 1: Engineering knowledge | 1.2 | 1.2.2 |
| CO3 | PO 5: Modern tool usage | 5.2 | 5.2.2 |
| CO4 | PO 5: Modern tool usage | 5.2 | 5.2.2 |
| CO5 | PO 1: Engineering knowledge<br>PO 7: Environment and sustainability | 1.6<br>7.2 | 1.3.1<br>7.2.1 |

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APE0304 | Nano Technology | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 To identify the essential concepts used in nanotechnology
CO: 2 To identify the materials, properties
CO: 3 To Derive charecterization techniques
CO: 4 To Characterization of carbon allotropes, synthesis of diamond.
CO: 5 To derive Applications in material science, biology and medicine.

**UNIT-I**

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

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

**UNIT-II**

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

**UNIT-III**

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

**UNIT-IV**

CARBON NANO TECHNOLOGY: Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalling diamond films, grapheme, applications of carbon nano tubes.

**UNIT-V**

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

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**TEXT BOOK:**

1. Nano science and nano technology / M.S Ramachandra Rao, Shubra Singh/Wiley publishers.
2. Introduction to Nanotechnology by Risal Singh, Shipra Mital Gupta, Oxford Higher Education, First Publication 2016.

**REFERENCE BOOKS:**

1. Introduction to Nano Technology /Charles P. Poole, Jr., Frank J.Owens/Wiley publishers.
2. Nanotechnology /Jermy J Ramsden/Elsevier publishers
3. Nano Materials/A.K.Bandyopadhyay/ New Age
4. Nano The Essentials, T.Pradeep, McGrawHill, 2014
5. Nanotechnology the Science of Small / M.A Shah, K.A Shah/Wiley Publisher

| List of COs | PO no. and keyword | Competency Indicator | Performance Indicator |
|---|---|---|---|
| CO: 1 | PO 2: Problem analysis | 2.5 | 2.1.3 |
| CO: 2 | PO 1: Engineering knowledge<br>PO 2: Problem analysis | 2.2 | 2.2.3 |
| CO: 3 | PO 1: Engineering knowledge<br>PO 2: Problem analysis | 2.1 | 2.1.3 |
| CO: 4 | PO 1: Engineering knowledge<br>PO 2: Problem analysis<br>PO 3: Design/development of solutions | 2.2 | 2.2.3 |
| CO: 5 | PO 1: Engineering knowledge<br>PO 2: Problem analysis | 2.4 | 2.4.3 |

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APE0305 | Composite materials | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites..
CO: 2 To develop knowledge on manufacturing methods of composites
CO: 3 To develop knowledge on processing techniques and applications of PMCs
CO: 4 To develop knowledge on processing techniques and applications of PMCs
CO: 5 To develop knowledge on processing techniques and applications of CMCs and Carbon- carbon composites

**Unit I: Introduction:** Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites

**Unit II: Manufacturing methods:** Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface. Measurement of interface strength, Characterization of systems; carbon fibre /epoxy, glass fibre / polyester, etc.

**Unit III: Processing of Polymer Matrix Composites:** Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding with Bulk Moulding Compound and sheet Moulding Compound – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding.

**Unit IV: Processing of Metal Matrix Composites:** Metallic matrices: aluminium, titanium, magnesium, copper alloys – processing of MMCs: liquid state, Solid state, fabrication techniques – diffusion bonding – powder metallurgy techniques- interfaces in MMCs – mechanical properties – machining of MMCs – Applications.

**Unit V: Processing of Ceramic Matrix Composites and Carbon-carbon Composites**: Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, mechanical properties and applications of CMCs – Carbon-carbon Composites –applications.

**Text Books and Reference Books:**

1. Engineering Mechanics of Composite Materials- Isaac and M Daniel, Oxford University Press, 1994
2. Mechanics of Composite Materials, R. M. Jones, Mc GrawHill Company, New York, 1975
3. Mechanics of Composite Materials, Second Edition (Mechanical Engineering)- Autar K. Kaw, Publisher: CRC

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4. .Mallick, P.K. and Newman.S., Composite Materials Technology, Hanser Publishers,2003.
5. Seamour, E.B. Modern Plastics Technology, Prentice Hall,2002
6. ASM Handbook – Composites, Vol-21, 2001, ISBN: 978-0-87170-703-1.
7. Composite Materials Science and Engineering, Krishan K. Chawla, Springer, 2009

**Additional Sources**

Youtube: https://nptel.ac.in/courses/112/104/112104229/

| List of COs | PO no. and keyword | Competency Indicator | Performance Indicator |
|---|---|---|---|
| CO: 1 | PO 1: Engineering knowledge | 1.3 | 1.3.1 |
| CO: 2 | PO 1: Engineering knowledge | 1.3 | 1.3.1 |
| CO: 3 | PO 1: Engineering knowledge | 1.3 | 1.3.1 |
| CO: 4 | PO 1: Engineering knowledge | 1.3 | 1.3.1 |
| CO: 5 | PO 1: Engineering knowledge | 1.3 | 1.3.1 |

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APE0306 | Renewable Energy Technologies | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 Explain the current energy scenario and requirement of migration to renewable energy sources
CO: 2 To understand role significance of solar energy
CO: 3 To provide importance of Wind Energy
CO: 4 To understand the role of ocean energy in the Energy Generation
CO: 5 To understand role of hydrogen in non conventional energy

**UNIT I**

**Classification of Energy:**

Energy chain and common forms of usable energy- Present energy scenario- World energy status- Energy scenario in India- Introduction to renewable energy resources- Introduction to solar Energy- Energy from sun- Spectral distribution of Solar radiation- Instruments for measurement of solar radiation.

**UNIT II**

**Solar Energy**

Solar Radiation, Measurements of Solar Radiation, Flat Plate and Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications.

**UNIT III**

**Bio Energy Sources:**

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gasdigesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

**Wind Energy:**

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generator.

**UNIT IV**

**Ocean Energy:**

Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants.

**Geothermal Energy:**

Resources, types of wells, methods of harnessing the energy, scope in India.

**Unit – V:**

**Hydrogen Energy**:

Properties of hydrogen as fuel, Hydrogen pathways introduction-current uses, general introduction to infrastructure requirement for hydrogen production, storage, dispensing and utilization, and hydrogen production plants.

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**Textbooks:**

1. Non-Conventional Energy Sources /G.D. Rai.
2. Reneweble energy resources: Tiwari and ghosal, Narosa publication.
3. Non conventional Energy Sources, Khanna Publication.

**References:**

1. Non-Conventional Energy Resources, B.H. Khan, McGrawHIll, 2015.
2. Principles of Solar Energy/ Frank Krieth & John F Kreider.
3. Fang Lin You, Hong ye (2012), Renewable Energy Systems, Advanced conversion technologies and applications, CRC Press
4. John.A.Duffie, William A.Beckman (2013), Solar Engineering of Thermal processes, Wiley
5. Godfrey Boyle (2012), Renewable Energy, power for a sustainable future, Oxford University Press.

| List of COs | PO no. and keyword | Competency Indicator | Performance Indicator |
|---|---|---|---|
| CO: 1 | PO 1: Engineering knowledge | 1.3 | 1.3.1 |
| CO: 2 | PO 5: Modern tool usage | 5.2 | 5.2.2 |
| CO: 3 | PO 5: Modern tool usage | 5.2 | 5.1.2 |
| CO: 4 | PO 5: Modern tool usage | 5.2 | 5.2.2 |
| CO: 5 | PO 1: Engineering knowledge | 1.6 | 1.3.1 |

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**Year: III** **Semester : I** **Branch of Study : Common to all**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19AHSMB01 | Managerial Economics and Financial Analysis | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 Understand the fundamentals of Economics and Managerial economics viz., Demand, Production, cost, revenue and markets.
CO: 2 Apply the Concept of Production cost and revenues for effective Business decision
CO: 3 Analyze how to invest their capital and maximize returns.
CO: 4 Evaluate the capital budgeting techniques.
CO: 5 Define the concepts related to financial accounting and management and able to develop the accounting statements and evaluate the financial performance of business entity

**UNIT - I Managerial Economics**

Introduction – meaning, nature, meaning, significance, functions, and advantages, ME and its role in other fields. Demand - Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing forecasting, Methods.

**UNIT - II Production and Cost Analysis**

Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least- cost combination– Short run and Long run Production Function- Isoquants and Isocosts, MRTS - Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale. Cost & Break-Even Analysis - Cost concepts and Cost behavior- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations of Break-Even Analysis.

**UNIT - III Business Organizations and Markets**

Introduction – Nature, meaning, significance, functions and advantages. Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies

**UNIT - IV Capital Budgeting**

Introduction to Capital, Sources of Capital. Short-term and Long-term Capital : Working capital, types, Estimating Working capital requirements. Capital Budgeting – Features, Proposals, Time value of money. Methods and Evaluation of Projects – Pay Back Method, Accounting Rate of Return (ARR), Net Present Value (NPV), and Internal Rate Return (IRR) Method (simple problems).

**UNIT - V Financial Accounting and Analysis**

Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions- Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Financial Analysis - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

**Textbooks:**

1. Varshney&Maheswari: Managerial Economics, Sultan Chand, 2013.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH, 2019

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**Reference Books:**

1. Ahuja Hl Managerial economics Schand,3/e,2013
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International, 2013.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage, 2013.

**Online Learning Resources:**

https://www.slideshare.net/123ps/managerial-economics-ppt
https://www.slideshare.net/rossanz/production-and-cost-45827016
https://www.slideshare.net/darkyla/business-organizations-19917607
https://www.slideshare.net/balarajbl/market-and-classification-of-market
https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396
https://www.slideshare.net/ashu1983/financial-accounting.

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APE0501 | Artificial Intelligence | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 Apply searching techniques for solving a problem
CO: 2 Design Intelligent Agents
CO: 3 Develop Natural Language Interface for Machines
CO: 4 Design mini robots
CO: 5 Summarize past, present and future of Artificial Intelligence

**UNIT I**

Introduction: What is AI, Foundations of AI, History of AI, The State of Art.
Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

**UNIT II**

Solving Problems by searching: Problem Solving Agents, Example problems, Searching for Solutions, Uninformed Search Strategies, Informed search strategies, Heuristic Functions, Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continues Spaces, Searching with Nondeterministic Actions, Searching with partial observations, online search agents and unknown environments.

**UNIT III**

Reinforcement Learning: Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, applications of RL
Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction.

**UNIT IV**

Natural Language for Communication: Phrase structure grammars, Syntactic Analysis, Augmented Grammars and semantic Interpretation, Machine Translation, Speech Recognition Perception: Image Formation, Early Image Processing Operations, Object Recognition by appearance, Reconstructing the 3D World, Object Recognition from Structural information, Using Vision.

**UNIT V**

Robotics: Introduction, Robot Hardware, Robotic Perception, Planning to move, planning uncertain movements, Moving, Robotic software architectures, application domains
Philosophical foundations: Weak AI, Strong AI, Ethics and Risks of AI, Agent Components, Agent Architectures, Are we going in the right direction, What if AI does succeed.

**Textbook:**

1. Stuart J.Russell, Peter Norvig, “Artificial Intelligence A Modern Approach”, 3rd Edition, Pearson Education, 2019.

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**References:**

Nilsson, Nils J., and Nils Johan Nilsson. Artificial intelligence: a new synthesis. Morgan Kaufmann, 1998.

Johnson, Benny G., Fred Phillips, and Linda G. Chase. "An intelligent tutoring system for the accounting cycle: Enhancing textbook homework with artificial intelligence." Journal of Accounting Education 27.1 (2009): 30-39

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APE0416 | Sensor Networks | 3 | 0 | 0 | 3 |

**Course Outcomes**:

CO: 1 Understand the concepts of Converters and Sensor data acquisitionsystems
CO: 2 Understand the concepts of Sensor Measurements in Structural Monitoring
CO: 3 Understand the concepts of commonly used sensing technologies and algorithms
CO: 4 Understand the concepts of Piezoelectric transducers for assessing and monitoring infrastructures
CO: 5 Understand the concepts of Fiber optic sensors for assessing and monitoring infrastructures

**Unit-1 Sensor data acquisition systems and architectures**

**Introduction,** General measurement system, Analog-to-digital converter architectures-Different types of ADCs – parallel comparator type ADC, Counter type ADC, successive approximation ADC and dual slope ADC Digital-to-analog conversion-Basic DAC techniques, Weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, Data acquisition systems-Analog Systems-Digital Systems.

**Unit-II Sensors and Sensing Technology for Structural Monitoring**

**Introduction, Sensor Types,** Sensor Measurements in Structural Monitoring- Structural Responses- Environmental Quantities- Operational Quantities- Typical Quantities for Bridge Monitoring- Fibre Optic Sensors- Classification of Fibre Optic Sensors- Typical Fibre Optic Sensors in SHM- Fibre Optic Sensors for Structural Monitoring- Wireless Sensors- Components of Wireless Sensors- Field Deployment in Civil Infrastructure.

**Unit-III Commonly** used sensors for civil infrastructures and their associated algorithms

**Introduction, commonly used sensing technologies-** Displacement-Strain-Acceleration-Environment **Associated algorithms-** Displacement sensors- Strain gages- Environmental measurements- **Examples of continuous monitoring systems.**

Unit-IV Piezoelectric transducers for assessing and monitoring civil infrastructures

Introduction, Principle of piezoelectricity, piezoelectric transducers for SHM applications, Bonding effects, Limitations of piezoelectric transducers, SHM techniques using piezoelectric transducers, Applications of piezoelectric transducer-based SHM.

Unit-V Fiber optic sensors for assessing and monitoring civil infrastructures

**Introduction,** Optical fiber concepts, Sensing mechanisms, Sensor packaging, Cables, connectors, and splicing, **Common optical fiber sensors-** Coherent interferometers, Low-coherence interferometers, Fiber Bragg gratings.

Text Books:

1. "Sensor Technologies for Civil Infrastructures", Volume 1 Sensing Hardware and Data Collection Methods for Performance Assessment Woodhead Publishing in Civil and Structural Engineering Ming L. Wang Jerome P. Lynch Hardcover ISBN: 9780857094322

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2. Wireless Sensor Networks for Civil Infrastructure Monitoring: A Best Practice Guide ICE Publishing David Rodenas-Herráiz, Kenichi Soga, Paul R A Fidler and Nicholas de Battista

**References:**

1. Ghatak A and Thyagarajan K. (1998) Introduction to Fiber Optics; Cambridge University Press: Cambridge, UK.
2. Barthorpe, R.J. and Worden, K. (2009) Sensor Placement Optimization. *Encyclopaedia of Structural Health Monitoring*, Boller, Chang and Fujino (ed.), John Wiley & Sons, Chichester, UK.

| List of COs | PO no. and keyword | Competency Indicator | Performance Indicator |
|---|---|---|---|
| CO: 1 | PO 1: Engineering Knowledge | 1.4 | 1.4.1 |
| CO: 2 | PO 2: Problem Analysis | 2.4 | 2.4.3 |
| CO: 3 | PO 2: Problem Analysis | 2.4 | 2.4.3 |
| CO: 4 | PO 3: Design/Development of solutions | 3.4 | 3.4.2 |
| CO: 5 | PO 3: Design/Development of solutions | 3.4 | 3.4.2 |

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19AMC9902 | Constitution of India | 2 | 0 | 0 | 0 |

**Course Outcomes**:

CO: 1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO: 2 Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO: 3 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO: 4 Discuss the Powers and functions of Governor, President, Judiciary.

CO: 5 Discuss the functions of local administration bodies

**Unit:1** **4 hrs**

History of Making of the Indian Constitution - History Drafting Committee, ( Composition & Working)

**Unit:2** **8 hrs**

Philosophy of the Indian Constitution - Preamble Salient Features

**Unit:3** **8hrs**

Contours of Constitutional Rights & Duties - Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties.

**Unit:4** **8hrs**

Organs of Governance - Parliament – Composition - Qualifications and Disqualifications - Powers and Functions - Executive, President, Governor - Council of Ministers -Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions.

**Unit:5** **8hrs**

Local Administration - District's Administration head: Role and Importance - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation - Pachayati raj: Introduction, PRI: ZillaPachayat - Elected officials and their roles, CEO Zilla Panchayat: Position and role - Block level: Organizational Hierarchy (Different departments) - Village level: Role of Elected and Appointed officials - Importance of grass root democracy.

**Suggested books for reading:**

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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| List of COs | PO no. and keyword | Competency Indicator | Performance Indicator |
|---|---|---|---|
| CO 1 | PO 6: The engineer and society | 6.2. | 6.2.1 |
| CO 2 | PO 6: The engineer and society | 6.2. | 6.2.1 |
| CO 3 | PO 6: The engineer and society | 6.2. | 6.2.1 |
| CO 4 | PO 6: The engineer and society | 6.2. | 6.2.1 |
| CO 5 | PO 6: The engineer and society | 6.2 | 6.1.1 |

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APC0311 | Thermal Engineering Lab | 0 | 0 | 2 | 1 |

**Course Outcomes**:

CO: 1 Understand different parts and mechanisms of IC Engine.
CO: 2 To understand the working principle of two and four stroke of IC Engine.
CO: 3 To understand the working principle and operation of diesel and petrol engine.
CO: 4 TO evaluate the performance characteristics of IC Engine and air compressor.
CO: 5 To understand measurements of engine emissions and study of boilers.

*Any Ten experiments from the following*

**List of Experiments:**

1. Valve / Port Timing Diagrams of an I.C. Engines
2. Performance Test on a 4 -Stroke Diesel Engines
3. Performance Test on 2-Stroke Petrol engine
4. Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Engine
5. Retardation and motoring test on 4- stroke engine
6. Heat Balance of an I.C. Engine.
7. Air/Fuel Ratio and Volumetric Efficiency of an I.C. Engines.
8. Performance Test on Variable Compression Ratio Engines for CI Engines
9. Performance Test on Reciprocating Air – Compressor Unit
10. Study of Boilers
11. Dismantling / Assembly of Engines to identify the parts and their position in an engine.
12. Engine Emission Measurement for SI & CI Engines.

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APC0305 | Machine Tools Lab | 0 | 0 | 2 | 1 |

**Course Outcomes**:

CO: 1 To apply knowledge of tool materials and cutting fluids in the machine shop
CO: 2 To develop the hands-on experience on different machining processes that will enable them to work in a typical machine shop.
CO: 3 To apply knowledge of metal cutting parameters, tool wear mechanisms
CO: 4 To understand the basic calculations of machining parameters.
CO: 5 To develop the practical knowledge on groove cutting, gear cutting

**List of Experiments:**

1. Demonstration of construction & operations of general-purpose machines: Lathe, drilling machine, Milling machine, Shaper, Planning machine, Slotting machine, Cylindrical Grinder, Surface grinder and Tool & cutter grinder.
2. Job on Step turning and taper turning on lathe machine
3. Job on Thread cutting and knurling on -lathe machine.
4. Job on Drilling and Tapping
5. Job on Shaping and Planning
6. Job on Slotting
7. Job on Milling (groove cutting/ gear cutting)
8. Job on Cylindrical and Surface Grinding
9. Job on Grinding of Tool angles.

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**Year: III** **Semester : I** **Branch of Study : ME**

| Subject Code | Subject Name | L | T | P | Credits |
|---|---|---|---|---|---|
| 19APC0315 | Computer Aided Drafting Lab | 0 | 0 | 2 | 1 |

**Course Outcomes**:

CO: 1 To understand the basic elements of Computer Aided Drafting
CO: 2 To aquire knowledge of drafting packages
CO: 3 To understand the drafting features
CO: 4 To practice drafting of solids and perspective views
CO: 5 To practice drafting of Orthographic views

**List of Experiments:**

I Introduction to Computer Aided Drafting software packages.

II. Practice on basic elements of a Computer Aided Drafting packages

III. Practice on features of a Computer Aided Drafting package

IV Drafting of Solids, Intersection of Solids

V Drafting of Perspective views

VI Drafting of Orthographic views of simple parts

Note: Any of the standard Software Packages like – Pro-E, Uni – Graphics, Catia …. Etc