**MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)**

# Open Elective Courses offered by Department of Mechanical Engineering MR20 Regulations - Effective from the Academic Year 2020 – 21 onwards

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| **S. No.** | **Branch** | **Course Code** | **Name of the Course** | **Credits** |
| 1. | **MECH** | A0330 | Energy Conservation and Energy Management | **3** |
| 2. | A0337 | Automobile Engineering | **3** |
| 3. | A0351 | Product Design and Development | **3** |
| 4. | A0359 | Total Quality Management | **3** |
| 5. | A0363 | Renewable Energy Sources | **3** |
| 6. | A0364 | Robotics | **3** |

**OPEN ELECTIVES**

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| **2020-21**  **Onwards (MR-20)** | **MALLA REDDY ENGINEERING COLLEGE**  **(Autonomous)** | **B.Tech.** | | |
| **Code: A0330** | **ENERGY CONSERVATION AND ENERGY MANAGEMENT**  (Open Elective) | **L** | **T** | **P** |
| **Credits:3** | **3** | **-** | **-** |

# Prerequisites: Nil

**Course Objectives:**

The students will be able to understand and analyze the energy data of industries, carryout energy

Accounting and balancing, conduct energy audit and suggest methodologies for energy savings and

Utilize the available resources in optimal ways

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| **MODULE I:** | **Introduction** |
| Energy - Power – Past & Present scenario of World; National Energy consumption Data –  Environmental aspects associated with energy utilization –Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing. | |

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| **MODULE II** | **Thermal Systems** |
| Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and ENCON  measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators &Refractory. | |

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| **MODULE III:** | **Lighting and Electrical Systems** |
| A: Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of ENCON in Illumination.  B: Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency  Computation, Energy Efficient Motors | |

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| **MODULE IV:** | **Energy Conservation in Major Utilities** |
| Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –  Cooling Towers – D.G. sets | |

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| **MODULE V** | **Economics** |
| Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value,  Life Cycle Costing –ESCO concept | |

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| **REFERENCE BOOKS** | |
| 1 | Witte. L.C., P.S. Schmidt, D.R. Brown, **“Industrial Energy Management and**  **Utilisation”,** Hemisphere Publ, Washington |
| 2  . | Callaghn, P.W. **“Design and Management for Energy Conservation”**, Pergamon Press,  Oxford |
| 3 | Dryden. I.G.C., **“The Efficient Use of Energy”** Butterworths, London |
| 4 | Steve Doty, Wayne C. Turner **“Energy Management Hand book”**, Fairmont Press; 8thEdition, 2012. |
| 5 | W.R. Murphy and G. McKay **“Energy Management”**, Butterworth-Heinemann Ltd, 2009 |
| **E - RESOURCES** | |
| 1 | <http://www.em-ea.org/> |
| 2 | https:/[/www](http://www.journals.elsevier.com/energy-conversion-and-management/).[journals.elsevier.com/energy-conversion-and-management/](http://www.journals.elsevier.com/energy-conversion-and-management/) |
| 3 | <http://aea-al.org/wp-content/uploads/2015/07/1118838254.pdf> |

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|  | **Course Outcomes** |
|  | At the end of the course, students will be able to |
|  | 1. Apply the energy management approaches and role of energy manager. |
|  | 1. Analyse energy conservation measures in lighting and electrical systems |
|  | 1. Apply the principles of thermal engineering and energy management to improve the performance of thermal systems. |
|  | 1. Analyse methods of energy conservation and energy efficiency for major utilities. |
|  | 1. Apply to economic analysis of energy utilization. |

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| **CO- PO Mapping (3/2/1indicatesstrengthofcorrelation)3-Strong,2-Medium,1-Weak** | | | | | | | | | | | | | | | |
| **COs** | **Programme Outcomes(POs)** | | | | | | | | | | | | **PSOs** | | |
| **PO**  **1** | **PO**  **2** | **PO**  **3** | **PO**  **4** | **PO**  **5** | **PO**  **6** | **PO**  **7** | **PO**  **8** | **PO**  **9** | **PO1**  **0** | **PO1**  **1** | **PO1**  **2** | **PSO**  **1** | **PSO**  **2** | **PSO**  **3** |
| **CO1** | **3** | **2** | **2** | **1** |  |  |  |  |  |  |  | **1** | **2** |  |  |
| **CO2** | **3** | **2** | **2** | **1** |  |  |  |  |  |  |  | **1** | **2** |  |  |
| **CO3** | **3** | **2** | **2** | **1** |  |  |  |  |  |  |  | **1** | **2** |  |  |
| **CO4** | **2** | **2** | **2** | **1** |  |  |  |  |  |  |  | **1** | **2** |  |  |
| **CO5** | **2** | **2** | **2** | **1** |  |  |  |  |  |  |  | **1** | **2** |  |  |

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| **2020-21**  **Onwards (MR-20)** | **MALLA REDDY ENGINEERING COLLEGE**  **(Autonomous)** | **B.Tech.** | | |
| **Code: A0337** | **AUTOMOBILE ENGINEERING**  (Open Elective) | **L** | **T** | **P** |
| **Credits: 3** | **3** | **-** | **-** |

# Prerequisites: Nil

**Course Objectives:**

The objective of this subject is to provide knowledge about various systems involved in automobiles.

# MODULE I: Introduction, Fuel System & C.I. Engines

Introduction : Components of four wheeler automobile – chassis and body – Types of chassis - power unit –power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, re boring, de carbonization, nitriding of crank shaft.

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. C.I. Engines: Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps.

# MODULE II: Cooling System & Ignition System

Cooling System : Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporating cooling – pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

# MODULE III: Emission, Electrical System & Safety Electronics

A: Emission from Automobiles: Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid fuels and gaseous fuels, electrical-their merits and demerits.

B: Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge. Safety electronics: electronics circuit airbag, anti slip regulation (ASR), electronic stability programs (ESP).

# MODULE IV: Transmission System

Transmission System: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch,

magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

# MODULE V: Suspension, Braking & Steering System

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system, active and passive suspensions, magnetic dampers. Braking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes, antilock braking systems (ABS) and EBS.

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

# TEXT BOOKS

1. Kirpal Singh, “**Automobile Engineering”, Vol.1 & 2**, Seventh Edition, Standard Publishers, 1997.
2. Jain K.K. and Asthana. R.B, “**Automobile Engineering**” Tata McGraw Hill Publishers, 2002.

# REFERENCES

1. Newton, Steeds and Garet, “**Motor Vehicles**”, Butterworth Publishers,1989.
2. Joseph Heitner, “**Automotive Mechanics**,” Second Edition, East-West Press, 1999.
3. Martin W, Stockel and Martin T Stockle , “**Automotive Mechanics Fundamentals**,” The Good heart –Will Cox Company Inc, USA, 1978.
4. Heinz Heisler, “**Advanced Engine Technology**”, SAE International Publications USA, 1998.
5. Ganesan V. “**Internal Combustion Engines**”, Third Edition, Tata McGraw-Hill, 2007.

# E - RESOURCES

1. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring- 2008/
2. <http://test.araiindia.com/index.php?option=com_content&view=article&id=36&Itemid=36>
3. <http://www.dli.ernet.in/handle/2015/205420>
4. International Journal of Automotive Technology - [http://www.springer.com/engineering/mechanical+engineering/journal/12239](http://www.springer.com/engineering/mechanical%2Bengineering/journal/12239)

# Course Outcomes

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

* 1. Understand the various vehicle structure and Components of IC engine.
  2. Gain Knowledge in various auxiliary systems used in an automobile.

4. Understand the principle and application of Transmission systems in an automobile.

1. Demonstrate the use of steering, braking and suspension systems in an automobile.
2. Apply the advantages of various alternative energy source

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| **CO- PO Mapping**  **(3/2/1 indicates strength of correlation) 3-**  **Strong, 2-Medium, 1-Weak** | | | | | | | | | | | | | | | |
| **CO**  **s** | **Programme**  **Outcomes(POs)** | | | | | | | | | | | | **PS**  **Os** | | |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO**  **11** | **PO1**  **2** | **PSO1** | **PS**  **O2** | **PS**  **O3** |
| **CO1** | **2** |  | **2** | **3** | **3** |  | **1** |  |  |  | **1** | **1** | **1** |  |  |
| **CO2** | **3** | **3** | **2** | **3** | **3** |  | **1** |  |  |  | **1** | **1** | **1** |  |  |
| **CO3** | **3** | **2** | **3** | **2** | **3** | **1** | **1** |  |  |  | **1** | **2** | **1** |  |  |
| **CO4** | **2** | **3** | **3** | **3** | **3** | **1** | **1** |  |  |  |  |  | **2** | **2** |  |
| **CO5** | **2** | **3** | **3** | **3** | **3** | **3** | **1** |  |  |  | **1** | **1** | **2** | **2** |  |

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| **2020-21**  **Onwards (MR-20)** | **MALLAREDDY ENGINEERINGCOLLEGE**  **(Autonomous)** | **B.Tech.** | | |
| **Code: A0351** | **PRODUCT DESIGN AND DEVELOPMENT**  (Open Elective) | **L** | **T** | **P** |
| **Credits: 3** | **3** | **-** | **-** |

# Prerequisites: Nil Course Objectives:

The students will be able to get knowledge about product development, specifications, concepts

and architecture which is followed in the industry.

# MODULE I: Product Development

Product development versus design, product development process, product cost analysis, cost models, reverse engineering and redesign product development process, new product development, tear down method.

# MODULE II: Product Specifications

Establishing the product specifications– Target specifications – Refining specifications, concept generation-Clarify the problem – Search internally – Search externally – Explore systematically - Reflect on the Results and the Process.

# MODULE III: Product Concepts

A: Concept generation, product configuration, concept evaluation and selection, product embodiments.

B: Quality function deployment, product design specification, physical prototypes-types and technique, dimensional analysis, design of experiments.

# MODULE IV: Product Architecture

Concept selection- Screening – scoring, Product architecture – Implication of architecture - Establishing the architecture – Related system level design issues.

# MODULE V:Product Improvement

Reliability, failure identification techniques, Poka-Yoke, Design for the environment, design for maintainability, product safety, liability and design, design for packaging, factorial analysis- ANOVA, factorial experiments, examples.

# TEXT BOOKS

1. Kevin Otto and Kristin Wood, “**Techniques in Reverse Engineering and New Product Development”**, Pearson Education, Chennai, Edition III, 2014.
2. Karl T.Ulrich and Steven D.Eppinger “**Product Design and Development**”,

McGrawHill International, 4th Edition, 2014.

# REFERENCES

* 1. Chitale A.V. and Gupta R.C., “**Product Design and Manufacturing**”, 6th Edition, PHI, 2013.
  2. Kemnnech Crow, “**Concurrent Engg. Integrated Product Development**”, DRM Associates, 26/3 via Olivera, Palas Verdes, CA 90274 (310) 377-569, Workshop Book.
  3. Stephen Rosenthal, “**Effective Product Design and Development**”, Business OneOrwin

Homewood, 1992, ISBN, 1-55623-603-434.

* 1. Stuart Pugh, "**Total Design – Integrated Methods for successful Product Engineering**", Addison Wesley Publishing, Neyourk, NY, 1991, ISBN 0-202-41639-5.

# E - RESOURCES

1. nptel.ac.in/courses/112107217/
2. nptel.ac.in/courses/112107143/26
3. nptel.ac.in/courses/112107217/14
4. nptel.ac.in/courses/112107143/35
5. nptel.ac.in/courses/112107217/10

# Course Outcomes

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

1. Apply the concept for new product development.
2. Apply knowledge on the concepts of product specification.
3. Describe the principles of industrial design and prototyping.
4. Apply knowledge on product architecture.
5. Examine the concept of product development and customer needs.

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| **CO- PO Mapping**  **(3/2/1 indicates strength of correlation) 3-**  **Strong, 2-Medium, 1-Weak** | | | | | | | | | | | | | | | |
| **CO**  **s** | **Programme**  **Outcomes(POs)** | | | | | | | | | | | | **PS**  **Os** | | |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO**  **11** | **PO1**  **2** | **PSO1** | **PS**  **O2** | **PS**  **O3** |
| **CO1** | **1** |  | **3** |  | **3** |  |  |  |  |  |  | **2** | **3** |  | **2** |
| **CO2** | **1** |  | **3** |  | **3** |  |  |  |  |  |  | **2** | **3** |  | **2** |
| **CO3** | **1** |  | **3** |  | **3** |  |  |  |  |  |  | **2** | **3** |  | **2** |
| **CO4** | **1** |  | **3** |  | **3** |  |  |  |  |  |  | **2** | **3** |  | **2** |
| **CO5** | **1** |  | **3** |  | **3** |  |  |  |  |  |  | **2** | **3** |  | **2** |

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| **2020-21**  **Onwards (MR-20)** | **MALLAREDDY ENGINEERINGCOLLEGE**  **(Autonomous)** | **B.Tech.** | | |
| **Code: A0359** | **TOTAL QUALITY AND MANAGEMENT**  (Open Elective) | **L** | **T** | **P** |
| **Credits: 3** | **3** | **-** | **-** |

# Prerequisites: Nil

**Course Objectives:**

To give the students an overview of quality and TQM and explaining the salient contributions of Quality Gurus like Deming, Juran and Crosby and general barriers in implementing TQM and also get basic knowledge about ISO.

# MODULE I: Introduction

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention - Costs of quality.

# MODULE II: TQM Principles

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

# MODULE III: Statistical Process Control (SPC)

A: Statistical fundamentals – Measures of central Tendency and Dispersion - Population and Sample.

B: Control Charts for variables and attributes, Industrial Examples. Process capability. Concept of six sigma – New seven Management tools.

# MODULE IV: TQM Tools

Bench marking -Reason to bench mark, Bench marking process - FMEA - Stages, Types. Quality Function Deployment (QFD) - House of Quality - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures

# MODULE V: Quality Systems

Need for ISO 9000 and Other Quality Systems - ISO 9000-2008 Quality System - Elements, Implementation of Quality System Documentation, Quality Auditing - QS 9000 - ISO 14000 - ISO 18000, ISO 20000, ISO 22000 TS 16949, ISO 14000, AS9100– Concept, Requirements and

benefits – case studies.

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# TEXT BOOKS

1. Dale H. Besterfiled,"**Total Quality Management**", 3rd, Pearson Education Asia, 2010.
2. Subburaj Ramasamy“ **Total Quality Management**” Tata McGraw - Hill publishers, 2012.

# REFERENCES

* 1. Suganthi.L and Anand Samuel, "**Total Quality Management**", Prentice Hall Pvt. Ltd., 2011.
  2. James R. Evans and William M. Lindsay, "**The Management and Control of Quality**", 8th Edition, Cengage Learning, 2012.
  3. Janakiraman. B and Gopal .R.K., "**Total Quality Management - Text and Cases**", Prentice Hall (India) Pvt. Ltd., 2006.
  4. Dr S. Kumar, “**Total Quality Management**”, Laxmi Publications Ltd., New Delhi 2015.
  5. P. N. Muherjee, “**Total Quality Management**”, Prentice Hall of India, New Delhi, 2006.

# E - RESOURCES

1. <https://src.alionscience.com/pdf/RAC-1ST/SOAR7_1st_Chapter.pdf>
2. <https://onlinecourses.nptel.ac.in/noc17_mg18>
3. nptel.ac.in/courses/122106032/Pdf/4\_2.pdf
4. [www.thecqi.org](http://www.thecqi.org/)
5. [www.emeraldinsight.com/journal/tqm](http://www.emeraldinsight.com/journal/tqm)

6. [www.emeraldinsight.com/doi/pdf/10.1108/09544789710367712](http://www.emeraldinsight.com/doi/pdf/10.1108/09544789710367712)

7. [www.statit.com/statitcustomqc/StatitCustomQC\_Overview.pdf](http://www.statit.com/statitcustomqc/StatitCustomQC_Overview.pdf)

# Course outcomes

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

1. Gain basic knowledge in total quality management relevant to both manufacturing and service industry.
2. Implement the basic principles of TQM in manufacturing and service based organization.
3. Apply various SPC tools in real time manufacturing and service industry.
4. Implement various TQM tools like FMEA & QFD.
5. Apply various ISO Standards for real time applications.

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| **CO- PO Mapping**  **(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak** | | | | | | | | | | | | | | | |
| **COs** | **Programme Outcomes(POs)** | | | | | | | | | | | | **PSOs** | | |
| **PO 1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO 6** | **PO 7** | **PO8** | **PO9** | **PO1 0** | **PO1 1** | **PO1 2** | **PSO 1** | **PSO 2** | **PSO 3** |
| **CO1** | **1** |  |  |  | **3** | **2** |  |  | **3** |  | **3** | **3** | **2** |  | **3** |
| **CO2** | **1** |  |  |  | **3** | **2** |  |  | **3** |  | **3** | **3** | **2** |  | **3** |
| **CO3** | **1** |  |  |  | **3** | **2** |  |  | **3** |  | **3** | **3** | **2** |  | **3** |
| **CO4** | **1** |  |  |  | **3** | **2** |  |  | **3** |  | **3** | **3** | **2** |  | **3** |
| **CO5** | **1** |  |  |  | **3** | **2** |  |  | **3** |  | **3** | **3** | **2** |  | **3** |

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| **2020-21**  **Onwards (MR-20)** | **MALLA REDDY ENGINEERING COLLEGE**  **(Autonomous)** | **B.Tech.** | | |
| **Code: A0363** | **RENEWABLE ENERGY SOURCES**  (Open Elective) | **L** | **T** | **P** |
| **Credits: 3** | **3** | **-** | **-** |

# Prerequisites: Nil Course Objectives:

The objective of this subject is to provide knowledge about different non-conventional energy sources.

# MODULE I: Principles of Solar Radiation

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

# MODULE II: Solar Energy

Solar Collectors: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Solar Energy Storage and Applications: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

# MODULE III: Wind Energy & Bio-Mass

A: Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

B: Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects.

# MODULE IV: Geothermal Energy & Ocean Energy

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India. Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants and their economics.

# MODULE V: Direct Energy Conversion

Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, merit, materials, applications. MHD generators - principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems. Electron gas dynamic conversion - economic aspects. Fuel cells - Principles of Faraday’s law’s, thermodynamic aspects, selection of fuels and operating conditions.

# TEXT BOOKS

* 1. G.D. Rai, “**Non-Conventional Energy Sources”,** Khanna publishers, 2011.
  2. Tiwari and Ghosal, “**Renewable Energy Resources”**, Narosa Publishing House, 2007.

# REFERENCES

1. Twidell & Weir, “**Renewable Energy Sources”,** Taylor and Francis Group Publishers,2015.
2. Sukhatme, **“Solar Energy”,** McGraw-Hill-third edition, 2008.
3. B.S Magal Frank Kreith& J.F Kreith “**Solar Power Engineering”,** McGraw-Hill Publications, 2010.
4. Frank Krieth & John F Kreider, “**Principles of Solar Energy”,** McGraw-Hill, 1981.
5. Ashok V Desai, “**Non-Conventional Energy**”, New International (P) Limited, 2003.

# E - RESOURCES

1. nptel.ac.in/courses/112105051/
2. <https://www.vssut.ac.in/lecture_notes/lecture1428910296.pdf>
3. faculty.itu.edu.tr/onbasiogl1/DosyaGetir/62002
4. <https://www.journals.elsevier.com/renewable-energy/>
5. [www.ijrer.org](http://www.ijrer.org/)

# Course Outcomes

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

1. Understand the principles of solar radiation
2. Recognize solar collectors, Solar energy storage and its applications
3. Classify the harvesting of wind energy & bio-mass energy.
4. Understand the harvesting of geothermal energy & ocean energy.
5. Apply the direct energy conversion methods

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| **CO- PO Mapping**  **(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak** | | | | | | | | | | | | | | | |
| **COs** | **Programme Outcomes(POs)** | | | | | | | | | | | | **PSOs** | | |
| **PO 1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO 6** | **PO 7** | **PO8** | **PO9** | **PO1 0** | **PO1 1** | **PO1 2** | **PSO 1** | **PSO 2** | **PSO 3** |
| **CO1** | **1** |  |  |  |  | **3** | **3** |  |  |  |  | **3** |  |  |  |
| **CO2** | **1** |  |  |  |  | **3** | **3** |  |  |  |  | **3** |  |  |  |
| **CO3** | **1** |  |  |  |  | **3** | **3** |  |  |  |  | **3** |  |  |  |
| **CO4** | **1** |  |  |  |  | **3** | **3** |  |  |  |  | **3** |  |  |  |
| **CO5** | **1** |  |  |  |  | **3** | **3** |  |  |  |  | **3** |  |  |  |

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| **2020-21**  **Onwards (MR-20)** | **MALLAREDDY ENGINEERINGCOLLEGE**  **(Autonomous)** | **B.Tech.** | | |
| **Code: A0364** | **ROBOTICS**  (Open Elective) | **L** | **T** | **P** |
| **Credits: 3** | **3** | **-** | **-** |

# Prerequisite: Nill

**Course Objectives:**

The objective of this subject is to provide knowledge of design of robot arm, kinematics and dynamics, Trajectory planning of robot and its applications in automation of Industries.

# Module – I: Introduction

Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

Components of the Industrial Robotics:-Degrees of freedom-End effectors: Mechanical gripper- magnetic-vacuum cup and other types of grippers

# Module – II: Motion Analysis & Manipulator Kinematics

**A: Motion Analysis:** Homogeneous transformations as applicable to rotation and translation – problems.

**B: Manipulator Kinematics:** Specifications of matrices, D-H notation joint coordinates and world coordinates.

# Module - III: Dynamics

Differential transformation and manipulators, Jacobians – problems. Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning,

# Module - IV: Robot actuators and Feedback components

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

# Module - V: Robot Application in Manufacturing:

Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting

# Text books:

* 1. Groover M P “**Industrial Robotics”,** Pearson Edu.
  2. Mittal R K & Nagrath I J “**Robotics and Control”,** TMH.

# Reference books:

1. Fu K S “**Robotics”,** McGraw Hill.

1. P. Coiffet and M. Chaironze “**An Introduction to Robot Technology”**, Kogam Page Ltd. 1983 London.
2. Richard D. Klafter “**Robotic Engineering”,** Prentice Hall Publishers
3. Asada and Slow time “**Robot Analysis and Intelligence”,** Wiley Inter-Science.
4. John J Craig “**Introduction to Robotics”,** Pearson Edu.
5. Mark W. Spong and M. Vidyasagar “**Robot Dynamics & Control”,** John Wiley & Sons (ASIA) Pvt Ltd.

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# Course outcomes:

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

* 1. Understand and analyse the basic concepts of automation and components of robotics.
  2. Solve the homogeneous transformation matrices for Forward and inverse kinematics –problems.
  3. Understand and analyse the trajectory planning of the robot.
  4. Understand the Robot actuators and Feedback components.
  5. Analyse the applications of robots in industries.

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| **CO- PO Mapping**  **(3/2/1 indicates strength of correlation) 3-Strong, 2-**  **Medium, 1-Weak** | | | | | | | | | | | | | | | |
| **CO**  **s** | **Programme**  **Outcomes(POs)** | | | | | | | | | | | | **PS**  **Os** | | |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO1**  **1** | **PO1**  **2** | **PSO1** | **PSO**  **2** | **PSO**  **3** |
| **CO1** | **3** |  | **2** | **2** | **3** |  | **3** |  |  |  | **2** |  |  | **1** |  |
| **CO2** | **1** | **3** | **3** | **2** |  |  |  |  |  |  |  | **1** |  |  | **1** |
| **CO3** | **3** | **3** | **2** | **3** |  |  |  |  |  |  |  | **1** |  | **3** |  |
| **CO4** | **2** |  | **3** | **2** |  |  | **2** |  |  |  | **3** | **3** |  |  | **3** |
| **CO5** | **2** |  | **2** |  | **2** |  | **3** |  |  |  | **2** | **3** |  | **3** | **3** |