



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
(Established by Govt. of A.P., Act. No. 30 of 2008)  
ANANTHAPURAMU – 515 002 (A.P) INDIA

*Revised Course Structure for B.Tech.- R13 Regulations*

**MECHANICAL ENGINEERING**

**III - II Semester**

| S.No | Course code | Subject   | Theory | Tu / Lab | Credits |
|------|-------------|---|--------|----------|---------|
| 1.   | 13A52501    | Managerial Economics & Financial Analysis.                                  | 3      | 1 -      | 3       |
| 2.   | 13A03601    | CAD/CAM.  | 3      | 1 -      | 3       |
| 3.   | 13A03602    | Machine Tools.  | 3      | 1 -      | 3       |
| 4.   | 13A03603    | Refrigeration & Air Conditioning.   | 3      | 1 -      | 3       |
| 5.   | 13A03604    | Design of Machine Members – II.   | 3      | 1 -      | 3       |
| 6.   | 13A03605    | <b>Choice Based Credit Courses</b><br>a. Non Conventional Source of Energy. | 3      | 1 -      | 3       |
|      | 13A03606    | b. Total Quality Management.  |        |          |         |
|      | 13A03607    | c. Mechatronics.  |        |          |         |
| 7.   | 13A03608    | CAD Lab.  | -      | - 4      | 2       |
| 8.   | 13A03609    | Machine Tools Lab.  | -      | - 4      | 2       |
| 9.   | 13A52502    | Advanced English Language Communication Skills Lab (Audit Course)           |        | 3        |         |
| 10   | 13A03610    | Comprehensive Online Examination – II                                       | -      | - -      | 1       |
|      |             |   | 18     | 6 11     | 23      |

  
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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech. III-II Sem. (M.E)** Th Tu C  
3 1 3  
**(13A52501) MANAGERIAL ECONOMICS & FINANCIAL ANALYSIS (MEFA)**

**Course Objective:**

*The objectives of this course are to equip the student with the basic inputs of Managerial Economics and Economic Environment of business and to enrich analytical skills in helping them take sound financial decisions for achieving higher productivity.*

**Learning Outcome:**

*The thorough understanding of Managerial Economics and Analysis of Financial Statements facilitates the Technocrats – cum – Entrepreneurs to take-up decisions effectively and efficiently in the challenging Business Environment.*

**UNIT I**

**INTRODUCTION TO MANAGERIAL ECONOMICS**

Managerial Economics - Definition, nature and scope – contemporary importance of Managerial Economics - Demand Analysis: Determinants- Law of Demand - Elasticity of Demand. Significance – types – measurement of elasticity of demand - Demand forecasting- factors governing demand forecasting- methods of demand forecasting –Relationship of Managerial Economics with Financial Accounting and Management.

**UNIT II**

**THEORY OF PRODUCTION AND COST ANALYSIS**

Production Function – Short-run and long- run production - Isoquants and Isocosts, MRTS, least cost combination of inputs - Cobb-Douglas production function - laws of returns - Internal and External economies of scale - **Cost Analysis:** Cost concepts - Break-Even Analysis (BEA) - Managerial significance and limitations of BEA - Determination of Break Even Point (Simple Problems)

**UNIT III**

**INTRODUCTION TO MARKETS AND NEW ECONOMIC ENVIRONMENT**

Market structures: Types of Markets - Perfect and Imperfect Competition - Features, Oligopoly - Monopolistic competition. Price-Output determination - Pricing Methods and Strategies. Forms of Business Organization – Sole Proprietorship- Partnership – Joint Stock Companies – Public Sector Enterprises – New Economic Environment- Economic systems – Economic Liberalization – Privatization and Globalization

**UNIT IV**

**CAPITAL AND CAPITAL BUDGETING**

Concept of Capital - Over and Under capitalization – Remedial measures - Sources of Short term and Long term capital - Estimating Working Capital requirement – Capital budgeting – Features of Capital budgeting proposals – Methods and Evaluation of Capital budgeting – Pay Back Method – Accounting Rate of Return (ARR) – Net Present Value (NPV) – Internal Rate Return (IRR) Method (simple problems)

**UNIT V**

**INTRODUCTION TO FINANCIAL ACCOUNTING AND ANALYSIS**

Financial Accounting – Concept - emerging need and importance - Double-Entry Book Keeping- Journal - Ledger – Trial Balance - Financial Statements - - Trading Account – Profit & Loss Account –

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Balance Sheet (with simple adjustments). Financial Analysis – Ratios – Techniques – Liquidity, Leverage, Profitability, and Activity Ratios (simple problems).

**Text Books:**

1. *Aryasri: Managerial Economics and Financial Analysis, 4/e, TMH, 2009.*
2. *Varshney & Maheswari: Managerial Economics, Sultan Chand, 2009.*

**Reference Books:**

1. *Premchand Babu, Madan Mohan: Financial Accounting and Analysis, Himalaya, 2009*
2. *S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International., 2009.*
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, 2009.*
5. *H.L.Ahuja: Managerial Economics, S.Chand, 3/e, 2009*

  
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 B.Tech. III-II sem. (M.E) Th Tu C  
3 1 3  
 (13A03601) CAD/CAM

**Course objective:**  
 The objective of the this subject is to enable the students to understand and handle design problems in symmetric manner, gain practical experience in handling 2-D drafting and 3-D modeling software systems, apply CAD in real life applications, understand the concepts G and M codes and manual part programming and know the applications of CNC machines. Further the students will become familiar on principles of computer graphics, geometric modeling, NC and CNC machines, group technology and FMS.

**UNIT I**  
 Overview of CAD/CAM: Product cycle, CAD, CAM and CIM. CAD Tools, CAM Tools, Utilization in an Industrial Environment, Evaluation criteria. CAD standards, CAD data structure, Data base management systems.  
 Computer Graphics: Co-ordinate systems, Graphics package functions, 2D and 3D transformations, homogeneous transformations, clipping, hidden line / surface removal colour, shading.

**Learning outcome & Suggested Student Activities:**  
 After completion of this unit students are able to understand the basic concepts Automation, components of CAD/CAM, input and output components of CAD, Steps involved in computer aided design.

**UNIT II**  
 Geometric Modeling: Representation techniques, Parametric and non parametric representation, various construction methods, wire frame modeling, synthetic curves and their representations, surface modeling, synthetics surfaces and their representations.  
 Solid modeling, solid representation, fundamentals, introduction to boundary representations, constructive solid geometry, analytical solid modeling.

**Learning outcome & Suggested Student Activities:**  
 After completion of this unit students are able to understand the geometric model of the component in CAD technology of computer graphics. The techniques of raster technology, scan conversion, clipping, removal of hidden lines and hidden surfaces, color, shading and texture.

**UNIT III**  
 Numerical Control: NC, NC Modes, NC Elements, NC Machine tools and their structure, Machining centre, types and features. Controls in NC, CNC systems, DNC systems. Adaptive control machining systems, types of adaptive control.  
 CNC Part Programming: Fundamentals, NC word, NC Nodes, canned cycles, cutter radius compensation, length compensation, computed assisted part programming using APT: Geometry statements, motion statements, post process statements, auxiliary statements, macro statement program for simple components.

**Learning outcomes & Suggested Student Activities:**  
 Geometric Modelling constitutes the most important and complex part in most of CDA software packages. Hence the students should focus on various requirements of information that are generated during geometric modeling stage, various types and its applications. Mathematical representations of curves used in geometric construction.

  
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#### UNIT IV

Group Technology & FMS: Part Family, Classification and Coding, advantages & limitations, Group technology machine cells, benefits. FMS: Introduction, components of FMS, material handling systems, Computer control systems, advantages.

Computer Aided Quality Control: Terminology in Quality control, Inspection and testing, Contact inspection methods - optical and non optical, integration of CAQC with CAD and CIM

##### **Learning outcome & Suggested Student Activities:**

*CNC has revolutionized the manufacturing automation. The flexibility of manufacturing achieved with the use of CNC and associated Technology. The students should aim to understand the principle of NC, CNC, Machining Centre and various methods of part programming. The student is advised to visit manufacturing industry where the CNC machines are using and also interact with CNC programmer in industry.*

#### UNIT V

Computer Aided Processes Planning: Retrieval type and Generative type, benefits Machinability data systems, Computer generated time standards.

Computer integrated production planning: Capacity planning, shop floor control, MRP-I, MRP-II, CIMS benefits. Trends in Manufacturing systems: Concepts of Reconfigurable manufacturing, Sustainable manufacturing and lean manufacturing.

##### **Learning outcomes & Suggested Student Activities:**

*Understanding the need of GT as a means of bringing the benefits of mass production to relatively smaller production. Understanding the need of computers in process planning and QC. Understanding the definition and concept of FMS, and its elements etc.*

##### **Text Books:**

1. CAD/CAM, A Zimmers&P.Groover, PE, PHI
2. CAD/CAM-Principles and applications, P.N. Rao, TMH, 3<sup>rd</sup> edition, 2010

##### **Reference Books:**

1. Automation, Production systems & Computer integrated Manufacturing, Groover, P.E
2. CAD/CAM/CIM, Radhakrishnan and Subramaniam, New Age, 3<sup>rd</sup> edition, 2008
3. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson
4. CAD/CAM Theory and Practice, R. Sivasubramaniam, TMH
5. Computer Aided Design and Manufacturing, K.Lalit Narayan, PHI, 2008.
6. Computer Aided Manufacturing, T.C. Chang, Pearson, 3<sup>rd</sup> edition, 2008
7. A text book of CAD/CAM, CSP Rao, Hitech Publ.

##### **Web References:**

[http://www.cadcamfunda.com/cam\\_computer\\_aided\\_manufacturing](http://www.cadcamfunda.com/cam_computer_aided_manufacturing)  
<http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf>

  
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(13A03602) MACHINE TOOLS

**Course Objective:**

*The objectives of this course are to introduce to demonstrate the fundamentals of machining processes and machine tools.*

*To develop knowledge and importance of metal cutting parameters, tool materials, cutting fluids and tool wear mechanisms.*

*To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes and acquire knowledge on advanced manufacturing processes. The students will have the knowledge and hands-on experience that will enable them to work in a typical machine shop.*

**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 .

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic concepts of the philosophy of metal cutting and the mechanism of chip formation. Student will understand the interface in the machining zone between the tool and the work piece and how the physical and mechanical parameters dictate the cutting performance.*

**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.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic concepts of turning. Student shall be made familiar with various tooling accessories used in turning and understand different constructions of lathe depending on the nature of operation.*

**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

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic principle of drilling, shaping and planning operation, parts of the drilling, shaping and planning machines and tool holding devices, operations performed on drilling, shaping and planning and machining calculations.*

  
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#### 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.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the principle of milling, grinding, Lapping, Honing and Broaching operation, parts of the milling machine and types of milling and grinding machines.*

#### 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

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping, Some examples of jigs and fixtures. The outcome of this unit is to understand the basic principle of unconventional machining methods USM,AJM,EDM,LBM,EBM,CM and ECM and machining of the USM,AJM,EDM,LBM,EBM,CM and ECM.*

**Text Books:**

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

**Reference Books:**

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

**Web Resources:**

[www.hgfarley.com](http://www.hgfarley.com)  
[www.kennametal.com/](http://www.kennametal.com/) - United States  
[www.mini-lathe.com/links.htm](http://www.mini-lathe.com/links.htm); [machinedesign.com/.../designer-s-guide-to-metalcutting-machinery-0608](http://machinedesign.com/.../designer-s-guide-to-metalcutting-machinery-0608) -  
[www.metalwebnews.com/wc.html](http://www.metalwebnews.com/wc.html)  
[www.britannica.com/EBchecked/topic/463000/planer](http://www.britannica.com/EBchecked/topic/463000/planer) [www.americanmachinist.com](http://www.americanmachinist.com)  
[www.machinetools.net.tw/parts/taiwan\\_voltage\\_regulator.htm](http://www.machinetools.net.tw/parts/taiwan_voltage_regulator.htm)

(13A03603) REFRIGERATION AND AIR CONDITIONING

**Course Objective:**

*This subject provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry. It gives details on how different components work and influence each other. Students will learn how real systems used in commercial, industrial refrigeration and air conditioning industries are built-up.*

*The objective this subject is to make the student to have complete knowledge on various refrigeration methods like VCR, VAR and latest developments, knowledge on various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.*

**UNIT I**

Introduction to Refrigeration: Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods  
Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - Numerical Problems – Refrigeration Needs of Air Crafts.

**Learning Outcome & Suggested Student Activities:**

*At the end of the chapter, student can able to understand the terminologies associated with refrigeration and also understand the basic principles of Refrigeration and applications. Student can also know the aspects of various natural refrigeration methods; understand the components of Air refrigeration system and the necessity of air craft refrigeration.*

*The following URLs are very useful to the students*

<http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20%20Lecture%201.pdf>

<http://www.ignou.ac.in/upload/Unit%201-32.pdf>, <http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%209.pdf>

**UNIT II**

Vapour Compression Refrigeration ( VCR ) System – Basic Cycle - Working Principle and Essential Components of The Plant – COP – Representation of Cycle On T-S and P-h Charts – Expander Vs. Throttling, Effect of Sub Cooling and Super Heating – Cycle Analysis – Actual Cycle- Influence of Various Parameters on System Performance – Construction and Use of P-h Charts – Numerical Problems. Refrigerants – Desirable Properties – Classification of Refrigerants Used – Nomenclature- Secondary Refrigerants- Lubricants – Ozone Depletion – Global Warming- Newer Refrigerants.

**Learning Outcome & Suggested Student Activities:**

*After the completion of the chapter, student can know the purpose and function of each of the components in the domestic refrigerator, analyzing the concepts of sub-cooling and super heating to improve the COP and also necessity of replacements for CFCs and HCFCs with new refrigerants. Following URLs are highly useful to the students*

[http://www.nptel.iitm.ac.in/courses/IITMADRAS/Applied\\_Thermodynamics/Module\\_6/6\\_Simple\\_Vapor\\_Compression\\_RS.pdf](http://www.nptel.iitm.ac.in/courses/IITMADRAS/Applied_Thermodynamics/Module_6/6_Simple_Vapor_Compression_RS.pdf)

[http://www.mcquay.com/mcquaybiz/literature/lit\\_ch\\_wc/AppGuide/AG31-007.pdf](http://www.mcquay.com/mcquaybiz/literature/lit_ch_wc/AppGuide/AG31-007.pdf)

  
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### UNIT III

Vapor Absorption Refrigeration ( VAR ) System – Description and Working of NH<sub>3</sub> – Water System and Li Br –Water ( Two Shell & Four Shell) System –Calculation of Max COP, Principle of Operation of Three Fluid Absorption System.

Steam Jet Refrigeration System: Working Principle and Basic Components-Estimation of Motive Steam Required, Principle and Operation of: (I) Thermo-Electric Refrigerator (Ii) Vortex Tube OrHilsch Tube.

#### **Learning Outcome & Suggested Student Activities:**

*After the completion of the chapter, student can know the purpose and function of each of the basic components of the absorption refrigeration system. Student can have knowledge on latest developments of Electroflux, thermo electric vortex tube methods. Following URLs are highly useful to the students*

[http://nptel.iitm.ac.in/courses/Webcourse-](http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%2014.pdf)

[contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%2014.pdf](http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%2014.pdf)

[http://en.wikipedia.org/wiki/Thermoelectric\\_cooling](http://en.wikipedia.org/wiki/Thermoelectric_cooling)

### UNIT IV

Introduction to Air Conditioning: Psychrometric Properties & Processes – Characterization of Sensible and Latent Heat Loads — Need For Ventilation, Consideration of Infiltrated Air – Heat Load Concepts.

Air Conditioning Systems: Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

#### **Learning Outcome & Suggested Student Activities:**

*After the end of the chapter, student can have knowledge on the use of psychrometric terms in Air conditioning. Student can learn the use of psychrometric chart to know psychrometric properties of air. Student can able to understand the terms sensible heat load and latent heat load. This technical information is fundamental to all types of domestic, commercial and industrial systems for the calculations of heat loads.*

*Student is advised to conduct experiment on A.C tutor in the laboratory. Following URLs are highly useful to the students*

<http://server.fst.uga.edu/kerr/FDST%204060/pdf%20files/7%20Psychrometrics.pdf>

<http://people.eng.unimelb.edu.au/mjbrear/436-432/chapter%208%20-%20psychrometry.pdf>

[http://nptel.iitm.ac.in/courses/Webcourse-](http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2031.pdf)

[contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2031.pdf](http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2031.pdf)

### UNIT V

Air Conditioning Equipment - Humidifiers – Dehumidifiers – Air Filters, Fans and Blowers.

Human Comfort: Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart.Heat Pump – Heat Sources – Different Heat Pump Circuits.

#### **Learning Outcome & Suggested Student Activities:**

*After the completion of the chapter, student can understand the components of A/C system and describe the cooling equipment combinations. Student can describe the concept of human comfort chart and the processes by which the body produces and rejects heat. Student can be familiar with the Heat pump circuit analysis. Following URLs are highly useful to the students*

*Effective temp-* <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2029.pdf>

[http://courses.washington.edu/me333afe/Comfort\\_Health.pdf](http://courses.washington.edu/me333afe/Comfort_Health.pdf)

<http://web.me.unr.edu/me372/Spring2001/Heat%20Pumps.pdf>

  
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**Text Books:**

1. Refrigeration and Air Conditioning, CP Arora, TMH, 13<sup>th</sup> edition, 2013.
2. A Course in Refrigeration and Air conditioning, S.C. Arora & Domkundwar, Dhanpatrai

**Reference Books:**

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2<sup>nd</sup> edition, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4<sup>th</sup> edition, 2007.
3. Refrigeration and Air Conditioning - P.L. Ballaney, 2<sup>nd</sup> edition, 2012.
4. Basic Refrigeration and Air-Conditioning – P.N. Ananthanarayanan / TMH, 4<sup>th</sup> edition, 2013.

**NOTE:** Tables/Codes: Thermal Engineering Data Book containing Réfrigérant and Psychrometric property Tables and charts are permitted in Exam

**Suggestions:**

The entire syllabus is covered in the text book – “ A Course in Refrigeration and Air conditioning “ by Domkundwar, Arora, Dhanpatrai Publications ( Highly useful book for GATE exam and other Government /Private sector competitive examinations)

Students can visit the nearby small scale Industries like Ice Plants to understand the principles of production of Ice and to observe the other simple components for practical understanding. Student is also advised to visit domestic refrigerator manufacturing industries/ Centralized and Split A/C system units.

Students are advised to watch the video lectures in the website - <http://nptel.iitm.ac.in>

The fundamental concepts of Thermodynamics, Psychrometrics etc., are required for better understanding of this subject.

**Web Resources:**

<http://www.refrigerationbasics.com/index.htm> <http://www.howstuffworks.com/ac.htm>

<http://www.ashrae.org>

<http://www.taftan.com/thermodynamics/AIRCOND.HTM>

<http://www.wisegeek.com/how-does-air-conditioning-work.htm>

  
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**B.Tech. III-II Sem. (M.E)** Th Tu C  
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**(13A03604) DESIGN OF MACHINE MEMBERS– II**

**Course Objective:**  
 To aware the student about basic concepts of curved beams with different cross sections, design of power transmission elements, understand the design concepts of various types of springs, various types of bearings and gears.  
 To know the students how to apply design concepts in designing of IC engine parts like Piston, cylinder, connecting rod and crank shaft.

**UNIT I**  
**DESIGN OF CURVED BEAMS:** Stresses in curved beams, Expression for radius of neutral axis for rectangular, circular, trapezoidal and T-Section. Design of crane hooks, C-clamps.  
**DESIGN OF POWER TRANSMISSIONS SYSTEMS:** Design of Flat belt drives, V-belt drives & rope drives. Selection of wire ropes, design procedure for chain drives.

**Learning Outcome & Suggested Student Activities:**  
 After completion of this unit students are able to design crane hooks, C-clamps and various belt, rope and chain drives. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of power transmission elements.  
<http://machinedesign.com/>  
<http://www.youtube.com/watch?v=PEKfS2Q1WqM&list=PL3D4EECFEFAA99D9BE&index=19>  
<http://www.youtube.com/watch?v=nMsB6Soz4Hc&list=PL3D4EECFEFAA99D9BE&index=30>

**UNIT II**  
**DESIGN OF MECHANICAL SPRINGS:** Stress and deflections of helical Springs-Springs for fatigue loading – Natural frequency of helical springs-Energy storage capacity- Helical Torsion springs- Design of leaf springs.  
**DESIGN OF POWER SCREWS:** Design of screw- Square, ACME and Buttruss screws- Efficiency of the screw. Design of compound screw, differential screw, ball screw- possible failures

**Learning Outcome & Suggested Student Activities:**  
 After completion of this unit, students are able to design helical springs for two wheel vehicle and laminated springs for trucks. Also students can apply design concepts in designing power screws. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of springs and power screws.  
<http://machinedesign.com/>  
<http://www.youtube.com/watch?v=PEKfS2Q1WqM&list=PL3D4EECFEFAA99D9BE&index=19>  
<http://www.youtube.com/watch?v=46quOD7V-cQ&list=PL3D4EECFEFAA99D9BE&index=28>

**UNIT III**  
**DESIGN OF BEARINGS:** Types of Journal bearings – Lubrication – Bearing Modulus-bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball & roller bearings, bearing life – Failure of bearings.

  
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**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design journal bearings, ball bearings and roller bearings and to know the advantages of rolling contact bearings against sliding contact bearings. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of bearings.

<http://machinedesign.com/>

<http://www.mae.ncsu.edu/klang/courses/mae442/Transmission/Journal%20Bearing.ppt>

[http://nhbb.com/files/catalog\\_pages/HiTech\\_Catalog.pdf](http://nhbb.com/files/catalog_pages/HiTech_Catalog.pdf)

**UNIT IV**

DESIGN OF SPUR & HELICAL GEARS: Spur gears- Helical gears – Load concentration factor – Dynamic load factor. Surface compressive strength – Bending strength – Design analysis of spur and Helical gears – Estimation of centre distance, module and face width. Check for dynamic and wear considerations.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design spur and helical gears for different input conditions. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of gears.

<http://machinedesign.com/>

[http://nptel.iitm.ac.in/courses/IIT-MADRAS/Machine\\_Design\\_II/pdf/2\\_9.pdf](http://nptel.iitm.ac.in/courses/IIT-MADRAS/Machine_Design_II/pdf/2_9.pdf)

<http://www.youtube.com/watch?v=8bml2pK6Ra0>

**UNIT V**

DESIGN OF IC ENGINE PARTS: Pistons– Construction, Design of piston. Cylinder, Cylinder block, Connecting Rod. Cranks and Crank shafts- Center and over hung cranks.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to know various forces acting on I C engine parts and failure criteria to be adopted for various parts. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of IC Engine parts.

<http://machinedesign.com/>

[http://umpir.ump.edu.my/1778/1/Design\\_Of\\_Coecting\\_Rod\\_Of\\_Internal\\_Combustion\\_Engine\\_A\\_Topology\\_Optimization\\_Approach.pdf](http://umpir.ump.edu.my/1778/1/Design_Of_Coecting_Rod_Of_Internal_Combustion_Engine_A_Topology_Optimization_Approach.pdf)

<http://www.d-p.com.gr/pistons/piston-designs.html>

**Text Books:**

1. MechanicalEngineeringDesign, Joseph E. Shigely, TMH Publishers, New Delhi, 9<sup>th</sup> edition, 2010.
2. Machine Design, R.L. Norton, Tata McGraw Hill Publishers, 2<sup>nd</sup> edition, 2012.

**Reference Books:**

1. Machine Design, Schaum's series, TMH Publishers, New Delhi, 1<sup>st</sup> edition, 2011
2. Design of Machine Elements, V.B. Bhandari, TMH Publishers, New Delhi, 2<sup>nd</sup> edition, 2013.
3. Machine Design, Sadhu Singh, Khanna Publishers, New Delhi
4. Design of Machine Elements, M.F. Spotts, PHIPublishers, New Delhi.
5. Machine Design, Pandya and Shah, Charotar Publishers, Anand, 17<sup>th</sup> edition, 2012.

**NOTE:** Design data books are permitted in the examinations.

**Web References:**

  
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<http://www.uni.edu/~rao/Md-17%20Shaft%20Design.pdf>  
<http://www.uni.edu/~rao/Md-13%20Keys%20and%20Couplings.pdf>  
<http://etidweb.tamu.edu/fip/ENTC463/Notes/ENTC463Key%20and%20Coupling.pdf>  
<http://www.science.howstuffworks.com/transport/engines.../bearing1.html>  
<http://www.fi.edu/time/Journey/Time/Escapements/gearint.html>

**Suggestions:**

1. students may visit nearby automobile workshops and machine tool shops to know about different machine elements like gears, bearings, springs, power screws, flexible drives and I C engine parts.
2. In addition to the text books students may also go through the reference books authored by V.B. Bhandari, by Pandya and Shah for more number of numerical problems.

  
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(13A03605) NONCONVENTIONAL SOURCES OF ENERGY

*Course Objective:*

*To create awareness to the student about basic concepts of non-conventional source of energy, to understand the process of collection, storage, conversion and applications of Solar Energy, Wind Energy, Bio Mass, OTEC. To learn about direct conversion methods.*

**UNIT – I**

**PRINCIPLES OF SOLAR RADIATION:** Role and potential of new and renewable source, the solarenergy 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.

**UNIT-II**

**SOLAR ENERGY COLLECTION:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**UNIT-III**

**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.

**WIND ENERGY:** Sources and potentials, horizontal and vertical axis windmills; performance characteristics, Betz criteria

**UNIT-IV**

**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.

**GEOTHERMAL ENERGY:** Resources, types of wells, methods of harnessing the energy, potential in India.

**UNIT-V**

**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.

**DIRECT ENERGY CONVERSION:** Need for DEC, Carnot cycle, limitations, and principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, Figure of 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, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions.

  
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**Outcomes:**

- *Understanding various Non-conventional sources of Energy.*
- *Able to learn how to use renewable energies instead of conventional fuels.*

**TEXT BOOKS:**

1. *Renewable energy resources/ Tiwari and Ghosal/ Narosa.*
2. *Non-Conventional Energy Sources /G.D. Rai*

**REFERENCES :**

1. *Renewable Energy Sources/ Twidell & Weir*
2. *Solar Energy/ Sukhatme*
3. *Solar Power Engineering/B.S.Magal Frank Kreith & J.F.Kreith.*
4. *Principles of Solar Energy/ Frank Krieth & John F Kreider.*
5. *Non-Conventional Energy/ Ashok V Desai/ Wiley Eastern*
6. *Non-Conventional Energy Systems/ K Mittal / Wheeler.*

  
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**(13A03606) TOTAL QUALITY MANAGEMENT**

**Course Objective:**

*To understand the concept of quality, cost of quality, international quality standards.*

*To learn the principles of Total quality management, techniques for problem solving.*

*To learn about various tools of quality management used in various industrial applications.*

**UNIT – I**

TQM – overview , concepts, elements – History-Quality management philosophies-Juran, Deming, Crosby , Feigenbaum, Ishikawa– Stages of Evolution– continuous improvement – objectives – internal and external customers.

Quality standards – Need of standardization - Institutions – bodies of standardization, ISO 9000 series – ISO 14000 series – other contemporary standards – ISO certification process- Third party audit.

**UNIT – II**

Process management- Quality measurement systems (QMS) – developing and implementing QMS – nonconformance database- TQM tools & techniques- 7 QC tools- 7 New QC tools. Problem Solving techniques - Problem Solving process – corrective action – order of precedence

**UNIT – III**

System failure analysis approach – flow chart – fault tree analysis – failure mode assessment and assignment matrix – organizing failure mode analysis – pedigree analysis. Quality circles – organization – focus team approach – statistical process control – process chart – Ishikawa diagram – preparing and using control charts.

**UNIT IV**

Quality Function Development (QFD) – elements of QFD – benchmarking-Types- Advantages & limitations of benchmarking – Taguchi Analysis – loss function - Taguchi design of experiments. Poka-yoke, Kaizen, Deming cycle.

**UNIT – V**

Value improvement elements – value improvement assault – supplier teaming. Business process reengineering & elements of Supply chain management. Six sigma approach – application of six sigma approach to various industrial situations.

**Outcomes:**

- Understanding the concepts of TQM.
- Able to use tools and techniques for problem solving.
- To formulate quality circles to find solutions to problems in industry.
- Analyze various quality problems and contribute towards continuous improvement in the system.

  
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**TEXT BOOKS:**

1. Total Quality Management by Joseph & Susan Berg
2. Total Quality Management by Besterfield, Pearson.

**REFERENCE BOOKS:**

1. Quality management by Howard Giltow-TMH
2. Quality management by Evans.
- 3 Quality management by Bedi

  
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(13A03607) MECHATRONICS

**Course Objective:**

To make the students to learn about the

Basic electronics, electrical and mechanical components used to control the machines and industries.

Various types of sensors, signal conditioning systems and various pneumatic and hydraulic components used in control systems.

Micro controllers, PLCS and PLC program and programmable motion control systems.

**UNIT I**

INTRODUCTION: Definition – Trends - Control Methods: Stand alone, PC Based (Real Time Operating Systems, Graphical User Interface, Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.

**Learning outcome & Suggested Student Activities:**

This unit helps the students to understand the importance of mechatronics subject and controlling the various machines, robots etc. Students may observe CNC machines in CAD/CAM lab to understand the mechatronics concepts.

Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 1, by the authors - W .Bolton, publishers - Pearson Education Press, 3rd edition, 2005.

Students may refer the following website [www.nptel.iitm.ac.in/ECE/mechatronics](http://www.nptel.iitm.ac.in/ECE/mechatronics)

[www.ustudy.in/mech/mechs](http://www.ustudy.in/mech/mechs) [en.wikipedia.org/wiki/mechatronics](http://en.wikipedia.org/wiki/mechatronics) for better understanding of this topic.

**UNIT II**

SIGNAL CONDITIONING: Introduction – Hardware - Digital I/O , Analog input – ADC , resolution , speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering.

**Learning outcomes & Suggested Student Activities:**

This unit helps the students to understand how to convert the analog signals into useful required form. These signal condition systems may be observed in electronics and communication engineering department labs.

Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter – 3, by the authors - W Bolton, publishers- Pearson Education Press, 3rd edition, 2005.

Students may refer the following website [www.nptel.iitm.ac.in/ECE/mechatronics](http://www.nptel.iitm.ac.in/ECE/mechatronics) [www.saylor.org/courses/me302](http://www.saylor.org/courses/me302) for better understanding of this topic.

**UNIT III**

PRECISION MECHANICAL SYSTEMS: Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Bearings- Motor / Drive Selection.

**Learning outcome & Suggested Student Activities:**

In this unit the students learn about the pneumatic and hydraulic systems and about some precisions mechanical component which are useful in the field of automation. This automation system can be observed in many processing industries and manufacturing industries to handle the materials and control the machines (or) process. Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter-5, 6 & 7 by the authors - W .Bolton, publishers - Pearson Education Press, 3rd editon, 2005. Students may refer the following website [www.pic-design.com](http://www.pic-design.com), [www.sdp-si.com](http://www.sdp-si.com), [www.csio.res.in](http://www.csio.res.in),

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#### UNIT IV:

ELECTRONIC INTERFACE SUBSYSTEMS: Motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers, over current sensing, resettable fuses, Power Supply - Bipolar transistors/ mosfets.

ELECTROMECHANICAL DRIVES: Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - PWM's - Pulse Width Modulation – Variable Frequency Drives.

##### **Learning outcome & Suggested Student Activities:**

*The objective of this unit is to make the student aware of electronic systems, electromechanical drives used in automation. Some of the systems may be observed electrical and electronics labs for better understanding. Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 7 by the authors – W. Bolton, publishers- Pearson Education Press, 3rd edition, 2005. Students may refer the following website [www.pic-design.com](http://www.pic-design.com), [www.sdp-si.com](http://www.sdp-si.com), [www.csio.res.info](http://www.csio.res.info) for better understanding of this topic.*

#### UNIT V

MICROCONTROLLERS OVERVIEW: 8051 Microcontroller , micro processor structure - Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors – Applications, Programming –Assembly.

PROGRAMMABLE LOGIC CONTROLLERS: Basic Structure - Programming: Ladder diagram - Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection, interface – R232 etc.,-Applications.

##### **Learning outcome & Suggested Student Activities:**

*This unit helps the student to know about microcontrollers and to programming of programmable logic controls. Students may visit pharmaceutical industries, thermal power plants etc. To observe the PLC based control systems. to know about the interface between processing equipment and central system. Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 13, 14 & 19 by the authors - W .Bolton, publishers- Pearson Education Press, 3rd edition, 2005. Students may refer the following website [www.authorstream.com](http://www.authorstream.com), [www.atmel.in](http://www.atmel.in), [www.lifehacker.com](http://www.lifehacker.com)*

##### **Text Books:**

1. *Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering* , W Bolton, Pearson Education Press, 3rd edition, 2005.
2. *Mechatronics*, M.D.Singh, J.G.Joshi, PHI.

##### **Reference Books:**

1. *Mechatronics Source Book*, Newton C Braga, Thomson Publications, Chennai.
2. *Mechatronics*, N. Shanmugam, Anuradha Agencies Publishers.
3. *Mechatronics System Design*, Devdas shetty, Richard, Thomson.

  
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(13A03608) CAD LAB

**COMPUTER AIDED DRAFTING (CAD)**

**LIST OF EXPERIMENTS:**

- I Introduction to CAD software
- II. 2D drafting using Auto CAD (Two exercises)
- III. 3D modeling using Auto CAD (Any four exercises)

Introduction to 3D Modeling Using Autocad Software

- 1. Modeling of Component in 3D – V block
- 2. Modeling of Component in 3D – Open Bearing
- 3. Modeling of Component in 3D – Angular block
- 4. Modeling of Component in 3D – Dovetail Guide
- 5. Modeling of Component in 3D – Dovetail Bracket
- 6. Modeling of Component in 3D – Dovetail stop
- 7. Geometric Modeling Using Pro-E or CATIA or solid works or iron CAD ( Any four exercises)

Assembly Modeling: Student must do at least two exercises

- 1. Assembly of a screw jack parts
- 2. Assembly of a knuckle joint
- 3. Assembly of a Oldham's coupling
- 4. Assembly of a footstep bearing
- 5. Assembly of a stuffing box
- 6. Assembly of a square tool post

  
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**(13A03609) MACHINE TOOLS LAB**

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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**(13A52502) ADVANCED COMM. SKILLS LAB (AUDIT COURSE)**

**Introduction:**

*The introduction of the Advanced Communication Skills Lab is considered essential at 3<sup>rd</sup> year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.*

*The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:*

- *Gathering ideas and information to organise ideas relevantly and coherently.*
- *Engaging in debates.*
- *Participating in group discussions.*
- *Facing interviews.*
- *Writing project/research reports/technical reports.*
- *Making oral presentations.*
- *Writing formal letters.*
- *Transferring information from non-verbal to verbal texts and vice-versa.*
- *Taking part in social and professional communication.*

**Course Objective:**

*This Lab focuses on using multi-media instruction for language development to meet the following targets:*

- *To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.*
- *Further, they would be required to communicate their ideas relevantly and coherently in writing.*
- *To prepare all the students for their placements.*

**Learning Outcome:**

- *Accomplishment of sound vocabulary and its proper use contextually*
- *Flair in Writing and felicity in written expression.*
- *Enhanced job prospects.*
- *Effective Speaking Abilities*

The following course content to conduct the activities is prescribed for the Advanced English Language Communication Skills (AELCS) Lab:

**UNIT I**

**COMMUNICATIVE COMPETENCY**

1. Reading Comprehension
2. Listening comprehension
3. Vocabulary for competitive purpose
4. Spotting errors

**UNIT II**  
**TECHNICAL WRITING**

1. Report writing
2. Curriculum vitae
3. Covering letter
4. E-mail writing

**UNIT III**  
**PRESENTATIONAL SKILLS**

1. Oral presentation
2. Power point presentation
3. Poster presentation
4. Stage dynamics

**UNIT IV**  
**CORPORATE SKILLS**

1. Dress code
2. Telephonic skills
3. Net Etiquettes

**UNIT V**  
**GETTING READY FOR JOB**

1. Group discussions
2. Interview skills
3. Psychometric tests

**Minimum Requirement:**

*The Advanced English Language Communication Skills (AELCS) Laboratory shall have the following infra-structural facilities to accommodate at least 60 students in the lab:*

- *Spacious room with appropriate acoustics.*
- *Round Tables with movable chairs*
- *Audio-visual aids*
- *LCD Projector*
- *Public Address system*
- *P – IV Processor, Hard Disk – 80 GB, RAM – 512 MB Minimum, Speed – 2.8 GHZ*
- *T. V, a digital stereo & Camcorder*
- *Headphones of High quality*

**Suggested Software:**

*The software consisting of the prescribed topics elaborated above should be procured and used.*

*K-VAN SOLUTIONS-Advanced communication lab*

1. *DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.*
2. *TOEFL & GRE( KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)*
3. *Train2success.com*

  
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