



Jawaharlal Nehru Technological University Anantapur

(Established by Govt. of A.P., Act. No. 30 of 2008)

Ananthapuramu-515 002 (A.P) India

**II year B.Tech
Course Structures and Syllabi
under R19 Regulations**

JNTUA Curriculum
Mechanical Engineering B. Tech Course Structure

2nd Year to 4th Years Course Structure

Semester - 3 (Theory - 6, Lab - 4)					
S.No	Course No	Course Name	Category	L-T-P	Credits
1.	19A54301	Complex Variables, Transforms and PDE	BS	2-1-0	3
2.	19A05304T	Python Programming	ES	2-1-0	3
3.	19A03301T	Manufacturing Processes	PC	3-0-0	3
4.	19A03302	Engineering Mechanics	PC	3-0-0	3
5.	19A03303T	Material Science and Engineering	PC	3-0-0	3
6.	19A99303T	Design Thinking & Product Innovation	ES	2-0-0	2
7.	19A99303P	Design Thinking & Product Innovation Lab	ES	0-0-3	1.5
8.	19A03301P	Manufacturing Processes Lab	PC	0-0-3	1.5
9.	19A03303P	Material Science and Engineering Lab	PC	0-0-3	1.5
10.	19A99301	Environmental Sciences	MC	3-0-0	0
Total					21.5

Semester - 4 (Theory - 6, Lab - 2)					
S.No	Course No	Course Name	Category	L-T-P	Credits
1.	19A54304	Numerical Methods and Probability theory	BS	2-1-0	3
2.	19A03401	Thermodynamics	PC	2-1-0	3
3.	19A03402T	Mechanics of Materials	PC	2-1-0	3
4.	19A01407	Fluid Mechanics and Hydraulic Machinery	PC	2-1-0	3
5.	19A05406T	Internet of Things	ES	2-0-2	3
6.	19A03403	Kinematics of Machinery	PC	2-1-0	3
7.	19A03404	Computer Aided Machine Drawing	PC	0-0-3	1.5
8.	19A03402P	Mechanics of Materials Lab	PC	0-0-3	1.5
9.	19A99302	Biology For Engineers	MC	3-0-0	0
Total					21

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech – II-I Sem

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19A54301 COMPLEX VARIABLES, TRANSFORMS & PARTIAL DIFFERENTIAL EQUATIONS

(Common to MECH & CIVIL)

Course Objective:

This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables. The aim is to analyze the solutions of partial differential equations.

Unit-I: Complex Variable – Differentiation:

Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions (exponential, trigonometric, logarithm), harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method-Conformal mappings-standard and special transformations ($\sin z$, e^z , $\cos z$, z^2) Mobius transformations (bilinear) and their properties.

Unit Outcomes:

Students will be able to

- Understand functions of Complex variable and its properties.
- Find derivatives of complex functions.
- Understand the analyticity of complex functions .
- Understand the conformal mappings of complex functions.

Unit-II: Complex Variable – Integration:

Line integral-Contour integration, Cauchy's integral theorem, Cauchy Integral formula, Liouville's theorem (without proof) and Maximum-Modulus theorem (without proof); power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (around unit circle, semi circle with $f(z)$ not having poles on real axis).

Unit Outcomes:

Students will be able to

- Understand the integration of complex functions.
- Apply Cauchy's integral theorem and Cauchy's integral formula.
- Understand singularities of complex functions.
- Evaluate improper integrals of complex functions using Residue theorem.

Unit-III: Laplace Transforms

Definition-Laplace transform of standard functions-existence of Laplace Transform – Inverse transform – First shifting Theorem, Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac's delta function – Convolution theorem – Laplace transform of Periodic function. Differentiation and integration of transform – solving Initial value problems to ordinary differential equations with constant coefficients using Laplace transforms.

Unit Outcomes:

Students will be able to

- Understand the concept of Laplace transforms and find the Laplace transforms of elementary functions.
- Find the Laplace transforms of general functions using its properties.
- Understand Laplace transforms of special functions(Unit step function, Unit Impulse & Periodic).
- Apply Laplace transforms to solve Differential Equations.

Unit-IV: Fourier series

Determination of Fourier coefficients (Euler's) – Dirichlet conditions for the existence of Fourier series – functions having discontinuity-Fourier series of Even and odd functions – Fourier series in an arbitrary interval – Half-range Fourier sine and cosine expansions- typical wave forms - Parseval's formula- Complex form of Fourier series.

Unit Outcomes:

Students will be able to

- Understand finding Fourier series expression of the given function.
- Determine Fourier coefficients (Euler's) and identify existence of Fourier series of the given function.
- Expand the given function in Fourier series given in Half range interval.
- Apply Fourier series to establish Identities among Euler coefficients.
- Find Fourier series of wave forms.

Unit-V: Partial Differential Equations & Applications

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of first order PDEs by Lagrange’s method- Solution of non linear PDEs (Standard forms)-Solution of second order PDEs by Method of separation of variables – Solutions of one dimensional wave equation, one dimensional heat equation under initial and boundary conditions.

Unit Outcomes:

At the end of this unit, the students will be able to

- Form Partial Differential Equations.
- Solve Partial Differential Equations of first order.
- Understand the method of separation of variables.
- Solve applications of Partial Differential Equations.

Course Outcomes:

After the completion of course, students will be able to

- Understand the analyticity of complex functions and conformal mappings.
- Apply Cauchy’s integral formula and Cauchy’s integral theorem to evaluate improper integrals along contours.
- Understand the usage of Laplace Transforms.
- Evaluate the Fourier series expansion of periodic functions.
- Formulate/solve/classify the solutions of Partial differential equations and also find the solution of one dimensional wave equation and heat equation.

Text Books:

1. B.S.Grewal , “Higher Engineering Mathematics”, Khanna publishers.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley India

Reference Books:

1. B.V.Ramana, “Higher Engineering Mathematics”, Mc Graw Hill publishers.
2. Alan Jeffrey, “Advanced Engineering Mathematics”, Elsevier.

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19A05304T PYTHON PROGRAMMING

Course Objectives:

- To learn the fundamentals of Python
- To elucidate problem-solving using a Python programming language
- To introduce a function-oriented programming paradigm through python
- To get training in the development of solutions using modular concepts
- To introduce the programming constructs of python

Unit – I

Introduction: What is a program, Running python, Arithmetic operators, Value and Types.

Variables, Assignments and Statements: Assignment statements, Script mode, Order of operations, string operations, comments.

Functions: Function calls, Math functions, Composition, Adding new Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters are local, Stack diagrams, Fruitful Functions and Void Functions, Why Functions.

Unit Outcomes:

Student should be able to

- List the basic constructs of Python.
- Solve the problems by applying modularity principle.

Unit – II

Case study: The turtle module, Simple Repetition, Encapsulation, Generalization, Interface design, Refactoring, docstring.

Conditionals and Recursion: floor division and modulus, Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Recursion, Infinite Recursion, Keyboard input.

Fruitful Functions: Return values, Incremental development, Composition, Boolean functions, More recursion, Leap of Faith, Checking types,

Unit Outcomes:

Student should be able to

- Apply the conditional execution of the program.
- Apply the principle of recursion to solve the problems.

Unit – III

Iteration: Reassignment, Updating variables, The while statement, Break, Square roots, Algorithms.

Strings: A string is a sequence, len, Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and Counting, String methods, The in operator, String comparison.

Case Study: Reading word lists, Search, Looping with indices.

Lists: List is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Map filter and reduce, Deleting elements, Lists and Strings, Objects and values, Aliasing, List arguments.

Unit Outcomes:

Student should be able to

- Use the data structure list.
- Design programs for manipulating strings.

Unit – IV

Dictionaries: A dictionary is a mapping, Dictionary as a collection of counters, Looping and dictionaries, Reverse Lookup, Dictionaries and lists, Memos, Global Variables.

Tuples: Tuples are immutable, Tuple Assignment, Tuple as Return values, Variable-length argument tuples, Lists and tuples, Dictionaries and tuples, Sequences of sequences.

Files: Persistence, Reading and writing, Format operator, Filename and paths, Catching exceptions, Databases, Pickling, Pipes, Writing modules.

Classes and Objects: Programmer-defined types, Attributes, Instances as Return values, Objects are mutable, Copying.

Classes and Functions:

Unit Outcomes:

Student should be able to

- Apply object orientation concepts.
- Use data structure dictionaries.
- Organize data in the form of files.

Unit – V

Classes and Functions: Time, Pure functions, Modifiers, Prototyping versus Planning

Classes and Methods: Object oriented features, Printing objects, The init method, The `__str__` method, Operator overloading, Type-based Dispatch, Polymorphism, Interface and Implementation

Inheritance: Card objects, Class attributes, Comparing cards, decks, Printing the Deck, Add Remove shuffle and sort, Inheritance, Class diagrams, Data encapsulation.

The Goodies: Conditional expressions, List comprehensions, Generator expressions, any and all, Sets, Counters, defaultdict, Named tuples, Gathering keyword Args,

Unit Outcomes:

Student should be able to

- Plan programs using object orientation approach.
- Illustrate the principle of inheritance.

Course Outcomes:

Student should be able to

1. Apply the features of Python language in various real applications.
2. Select appropriate data structure of Python for solving a problem.
3. Design object oriented programs using Python for solving real-world problems.
4. Apply modularity to programs.

Text books:

1. Allen B. Downey, “Think Python”, 2nd edition, SPD/O’Reilly, 2016.

Reference Books:

1. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018.
2. Kenneth A. Lambert, B.L. Juneja, “Fundamentals of Python”, Cengage, 2015.
3. R. Nageswara Rao, “Core Python Programming”, 2nd edition, Dreamtech Press, 2019

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19A03301T MANUFACTURING PROCESSES

Course Objectives:

- Working principle of different metal casting processes and gating system.
- Nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes.
- Principles of forging, tools and dies, working of forging processes.
- Classification of the welding processes, working of different types of welding processes and welding defects
- Classification, applications and manufacturing methods of plastics, ceramics and powder metallurgy.
- Learning Characteristics of Unconventional Machining Processes

UNIT I

8 hrs

Introduction : Importance and selection of manufacturing processes.

Casting Processes: Introduction to casting process, process steps; pattern: types, materials and allowance; Cores: Types of cores, core prints, principles and design of gating system; Solidification of casting: Concept, solidification of pure metal and alloy; Special casting processes: Shell casting, investment casting, die casting, centrifugal casting, casting defects and remedies.

Unit Outcomes:

At the end of this unit, the student will be able to

- Selection of suitable manufacturing process for a given product. (L3)
- Understand the steps involved in metal casting, pattern making. (L2)
- Apply the knowledge of designing gating systems, risers. (L3)
- Compare the working of various metal casting processes. (L4)
- Identify the various casting defects. (L3)

UNIT II

8hrs

Metal Forming: Introduction, nature of plastic deformation, hot and cold working of metals, mechanics of metal forming; Rolling: Principle, types of rolling mill and products, roll passes, forces in rolling and power requirements; Extrusion: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, wire drawing, tube drawing.

Forging: Principles of forging, tools and dies. Types: Smith forging, drop forging, forging hammers, rotary forging and forging defects. Sheet metal forming: Mechanics of sheet metal working, blanking, piercing, bending, stamping.

Unit Outcomes:

At the end of this unit, the student will be able to

- Compare cold working and hot working processes. (L4)
- Explain the working of rolling mills. (L2)
- Evaluate the forces and power in rolling and extrusion processes. (L5)
- Summarize the working of various extrusion processes. (L2)
- Identify the principles of forging, tools and dies. (L3)
- Summarize the various operations of Sheet metal forming. (L2)

UNIT III

8hrs

Metal Joining Processes: Classification of welding processes, types of welds and welded joints and V-I characteristics, arc welding, weld bead geometry, submerged arc welding, gas tungsten arc welding, gas metal arc welding. applications, advantages and disadvantages of the above processes, other fabrication processes. Heat affected zones in welding; soldering and brazing: Types and their applications, Welding defects: causes and remedies.

Unit Outcomes:

At the end of this unit, the student will be able to

- Classify the working of various welding processes. (L2)
- Compare V-I characteristics of different welding processes. (L4)
- Summarize the applications, advantages of various welding processes. (L2)
- Identify the defects in welding. (L3)

UNIT IV : Plastic Processing, Ceramics and Powder Metallurgy:

8hrs

Plastics: Types, properties and their applications, processing of plastics, extrusion of plastics, transfer molding and compression molding, injection molding, thermoforming, rotational molding and blow molding

Ceramics: Classification of ceramic materials, properties and their application, ceramic powder preparation; Processing of ceramic parts: Pressing, casting, sintering; Secondary processing of ceramics: Coatings, finishing.

Powder Metallurgy: Principle, manufacture of powders, steps involved.

Unit Outcomes:

At the end of this unit, the student will be able to

- Learn the methods of manufacturing plastics parts. (L2)
- Explain the steps in making ceramics parts. (L2)
- Explain the steps in manufacturing of powder metallurgy parts. (L2)
- Demonstrate the application of plastic, ceramics and power metallurgy. (L2)

UNIT V

10hrs

Unconventional Machining Processes: Electrical discharge machining (EDM), principle and processes parameters, electro-chemical machining (ECM) Laser beam machining (LBM), plasma arc machining (PAM) and electron beam machining

Principles and process parameters of Abrasive jet machining (AJM), water jet machining, ultrasonic machining

Unit Outcomes:

At the end of this unit, the student will be able to

- Identify different unconventional machining processes. (L3)
- Evaluate process parameters of EDM, ECM, LBM, PAM and AJM.(L5)
- Apply various unconventional machining processes. (L3)

Course Outcomes:

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

- Demonstrate different metal casting processes and gating systems. (L2)
- Classify working of various welding processes. (L2)
- Evaluate the forces and power requirements in rolling process. (L5)
- Apply the principles of various forging operations. (L3)
- Outline the manufacturing methods of plastics, ceramics and powder metallurgy. (L1)
- Identify different unconventional processes and their applications. (L3)

Text Books:

1. Rao P.N., “Manufacturing Technology – Volume I”, 5th edition, McGraw-Hill Education, 2018.
2. Kalpakjain S and Schmid S.R., “Manufacturing Engineering and Technology”, 7th edition, Pearson, 2018.

Reference Books:

1. Millek P. Groover, “Fundamentals of Modern Manufacturing”: “Materials, Processes and Systems”, 4th edition, John Wiley and Sons Inc, 2010.
2. Sharma P.C., “A Text book of Production Technology”, 8th edition, S Chand Publishing, 2014.

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19A03302 ENGINEERING MECHANICS

Course Objectives:

- Explain the effect of force and moment in different engineering applications.
- Teach centre of gravity and moment of inertia of solids and surfaces.
- Familiarize frictional forces in mechanical applications.
- Analysis of rigid bodies under dynamic conditions.

UNIT I

12 hours

Introduction to Engineering Mechanics: Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and concurrent coplanar forces, resultant of coplanar force systems couple, moment of a force Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction. Free body diagrams involving frictional forces.

Unit Outcomes:

At the end of this unit, the student will be able to

- Resolve the forces in mechanical systems (L2)
- Identify the moments and forces (L3)
- Draw free body diagram (L3)

UNIT II

10 hours

Analysis of Structures: Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.

Virtual Work: Equilibrium of ideal systems, work done by a force, work done by a couple, principle of virtual work.

Unit Outcomes:

At the end of this unit, the student will be able to

- Identify different types of trusses. (12)
- Analyze the plane trusses by method of joints and the method of sections. (14)
- Demonstrate equilibrium of ideal system. (12)
- Estimate the work done by a force and work done by a couple. (13)

UNIT III**10 hours**

Properties of Surfaces and Volumes: Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite sections, center of gravity of common volumes - cylinder, cone, sphere, theorem of Pappus-guldinus.

Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, mass moment of inertia of common volumes - thin plates, thin rod, cylinder, cone, sphere, rectangular prism, radius of gyration.

Unit Outcomes:

At the end of this unit, the student will be able to

- Identify the centre of gravity of composite sections. (L3)
- Determine the centre of gravity of common solids. (L3)
- Determine moment of inertia for composite volumes. (L3)

UNIT IV**10 hours**

Kinematics: Equations of motion for rigid bodies, constant and variable acceleration, rectilinear and curvilinear motion, motion under gravity -projectile motion, use of rectangular coordinates, tangential and normal coordinates, radius of curvature, rotation of a rigid body about a fixed axis, introduction to plane motion.

Unit Outcomes:

At the end of this unit, the student will be able to

- Write equations of motion for rigid bodies. (L3)
- Find velocity and acceleration in rectilinear and curvilinear motions (L4)
- Trace the path of projectile. (L3)

UNIT V

10 hours

Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.

Ideal Systems: Principle of conservation of energy, concept of power, conservation of linear and angular momentum, principle of momentum and impulse, impact - types of impact.

Unit Outcomes:

At the end of this unit, the student will be able to

- Apply D'Alembert's principle in rectilinear translation. (L3)
- Relate principle of work and energy in dynamic systems. (L3)
- Make use of principle of momentum and impulse to dynamic bodies. (L4)

Course Outcomes:

Upon successful completion of the course, the students will be able to

- Resolve forces and couples in mechanical systems. (L3)
- Identify the frictional forces and its influence on equilibrium. (L3)
- Find the centre of gravity and moment of inertia for various geometric shapes (L3)
- Develop equations for different motions. (L4)
- Determine the displacement, velocity and acceleration relations in dynamic systems (L4)
- Relate the impulse and momentum (L4)

Text books:

1. S S Bhavikatti, "Engineering Mechanics", 4th edition, New Age International, 2008.
2. S Timoshenko, DH Young, JV Rao, Sukumar Pati, "Engineering Mechanics (in SI units)", 5th edition, McGraw Hill, 2013.

Reference Books:

1. Basudeb Bhattacharya., "Engineering Mechanics", 2nd edition, Oxford University Press (India), 2015.
2. Irving Shames, G K M Rao, "Engineering Mechanics: Statics and Dynam-ics", 4th edition, Pearson, 2009.
3. K L Kumar, Veenu Kumar, "Engineering Mechanics", 4th edition, Tata McGraw Hill, 2010.

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19A03303T MATERIAL SCIENCE AND ENGINEERING

Course Objectives

- To teach the principles of physical metallurgy, i.e. crystallography of metals, constitution of alloys, phase diagrams.
- Expose commercially important metals and alloys (both ferrous and non ferrous) with engineering constraints.
- Explain the methods to change the properties of materials through heat treatment processes
- Familiarize properties and applications of ceramics, polymers and composite materials.
- Demonstrate the fundamental properties of nano-materials and their applications.

UNIT I

10 Hours

Structure of Metals: Crystal Structures: Unit cells, Metallic crystal structures, Imperfection in solids: Point, Line, interstitial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Constitution of Alloys: Necessity of Alloying, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-Iron-carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite, and cast iron.

Unit Outcomes:

At the end of this unit the student will be able to

- Explain the importance of material science in engineering.(L2)
- Recall the definitions and terminology of crystallography. (L1)
- Distinguish metals and alloys. (L4)
- Make use of the principles of construction of binary phase diagrams. (L3)
- Identify various invariant reactions in binary phase diagrams. (L3)
- Explain the concept of metallography in studying the microstructures of metals and alloys. (L2)

UNIT II

8 Hours

Steels:

Plain carbon steels, use and limitations of plain carbon steels. AISI& BIS classification of steels. Classification of alloys steels. Micro structure, properties and applications of alloy steels- stainless steels and tool steels.

Cast irons:

Micro structure, properties and applications of white cast iron, malleable cast iron, grey cast iron, nodular cast iron and alloy cast irons.

Unit Outcomes:

At the end of this unit the student will be able to

- Classify various types of steels, their properties and applications. (12)
- Identify various types of cast irons, their properties and applications. (13)
- Compare steels and cast irons and their limitations in applications. (13)

UNIT III

8 Hours

Heat Treatment of Steels: Annealing, tempering, normalizing and spheroidizing, isothermal transformation diagrams for Fe-Fe₃C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, and vacuum and plasma hardening

Unit Outcomes:

At the end of this unit the student will be able to

- Understand the importance of steel and iron - iron carbide phase diagram. (L2)
- Explain the influence of heat treatment in modification of properties of steels. (L2)
- Develop a heat treatment cycle based on properties required. (L3)
- Explain the principles of surface hardening methods. (L2)

UNIT IV

8 Hours

Non-ferrous Metals and Alloys: Micro structure, properties and applications of copper and its alloys, aluminium and its alloys. Study of Al-Cu phase diagram, precipitation hardening. Micro structure, properties and applications of titanium and its alloys.

Unit Outcomes:

At the end of this unit the student will be able to

- Explain the importance of non-ferrous metals and alloys in engineering applications. (L2)
- Demonstrate various properties and applications of non-ferrous alloys. (L4)
- Differentiate between hardening of ferrous and non-ferrous alloys. (L4)

UNIT V**8 Hours**

Ceramics, Polymers and Composites: Structure, properties and applications of ceramics, polymers and composites. Introduction to super alloys and nanomaterials.

Unit Outcomes:

At the end of this unit the student will be able to

- Explain the properties of ceramics and their applications. (L2)
- Summarize the properties of polymers and composites and their use. (L2)
- Interpret the properties of nano materials and their applications. (L2)
- Identify the difference between the micro and nano scale materials and their uses. (L3)

Course Outcomes:

After completing the course, the student will be able to

- Explain the principles of binary phases. (L2)
- Select steels and cast irons for a given application. (L3)
- Apply heat treatment to different applications. (L3)
- Utilize nonferrous metals and alloys in engineering. (L3)
- Choose composites for various applications. (L3)
- Assess the properties of nano-scale materials and their applications. (L2)

Text Book(s)

1. V.Raghavan, "Material Science and Engineering", 5th edition, Prentice Hall of India, 2004.
2. R.Balasubramaniam, Callister's "Material Science and Engineering", 2nd edition, Wiley India, 2014.

References

1. Y. Lakhtin, "Engineering Physical Metallurgy", University Press of the Pacific, 2000.
2. S.H.Avner, "Introduction to Physical Metallurgy", 2nd edition, Tata McGraw- Hill, 1997.
3. L.H.Van Vlack, "Elements of Material Science and Engineering", 6th edition, Pearson Education, 2008.
4. George E.Dieter, "Mechanical Metallurgy", 3rd edition, McGraw-Hill, 2013.

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19A99303T DESIGN THINKING AND PRODUCT INNOVATION

Design is a realization of a concept or idea into a configuration, drawing or a product. Design thinking is cognitive and practical processes by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end user. This course introduces the design thinking in product innovation.

Course Objectives:

- To bring awareness on innovative design and new product development.
- To explain the basics of design thinking.
- To familiarize the role of reverse engineering in product development.
- To train how to identify the needs of society and convert into demand.
- To introduce product planning and product development process.

UNIT I

Science to Engineering: Job of engineers, engineering units and measurement, elements of engineering analysis, forces and motion, energy, kinematics and motion, conversion of linear motion to rotary and vice versa, motion transmission.

Physics to Engineering: Application of Newton laws, Pascal's law, Bouncy, Bernoulli's theorem, Ohm's law, electrical induction in engineering products.

Unit Outcomes:

After completion of this Unit, the student will be able to

- Relate the principles of science to engineering (L2)
- Explain simple mechanics motion and force transmission (L2)
- Identify the laws of physics applied to engineering products (L3)

UNIT II

Historical Development: Invention wheel, early mechanics in design, mechanical advantages, industrial revolution, steam and petrol for mobility. Innovations in Electrical and Electronics: Electrical energy generation, electrical bulb, electrical equipment, electronics and automation, computing for early days to present, innovations in communications.

Unit Outcomes:

After completion of this Unit, the student will be able to

- Identify innovation in early mechanical designs (L2)
- Explain development of electrical equipment (L2)
- list out the developments in computing machines (L4)
- summarize innovations in communication systems (L2)

UNIT III

Systematic approach to product development: Design Thinking, Innovation, Empathize Design Thinking as a systematic approach to Innovation, brainstorming, visual thinking, design challenges, innovation, art of Innovation, strategies for idea generation, creativity, teams for innovation. Solution finding methods: Conventional, intuitive, discursive, methods for combining solution, decision making for new design.

Unit Outcomes:

After completion of this Unit, the student will be able to

- Explain the steps in the design process (L2)
- Apply systematic approach in design (L3)
- Develop strategies for new product development (L3)

UNIT IV

Reverse engineering in product development: Reversing engineering methods, identifying the bad features in a product, reduction in size and weight, usage of new materials, 3D printing, study of introducing electrical and electronic controls to the old products, importance of ergonomics in product development, environmental considerations in design, safety considerations in design.

Unit Outcomes:

After completion of this Unit, the student will be able to

- Understand reverse engineering methods in product development (L2)
- Use new materials to improve the product (L2)
- Apply electronic controls to improve the product acceptability (L3)
- Summarize the safety and environmental factors in new product design (L2)
- Understand 3D printing in manufacturing (L2)

UNIT V

Study of Product Development- Agriculture, development of machines for separation of corn seeds, peeling of groundnut shells, husk removing from paddy. Electrical: Design of burglar alarm, speedometer, water level indicator, smart gates, smart lights. Design of electrical vehicles, unmanned vehicles, design principles in drones.

Unit Outcomes:

After completion of this Unit, the student will be able to

- Identify the needs for new product development in agriculture (L3)
- Develop simple electrical gadgets (L3)
- Explain the principles in design electrical vehicles and drones (L2)

Course Outcomes

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

- summarize the importance of basic sciences in product development (L2)
- explain the historical developments in mechanical, electrical, communications and computational engineering (L3)
- apply systematic approach to innovative designs (L3)
- identify new materials and manufacturing methods in design (L3)

Text Book(s)

1. Philip Kosky, Robert T. Balmer, William D. Keat, George Wise, “Exploring Engineering: An Introduction to Engineering and Design”, 4th edition, Elsevier, 2016.
2. David Ralzman, “History of Modern Design”, 2nd edition, Laurence King Publishing Ltd., 2010
3. An AVA Book, “Design Thinking”, AVA Publishing, 2010.

Reference Books:

1. G. Pahl, W.Beitz, J. Feldhusen, KH Grote, “Engineering Design: A Systematic Approach”, 3rd edition, Springer, 2007.
2. Tom Kelley, Jonathan Littman, “Ten Faces in Innovation”, Currency Books, 2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech – II-I Sem

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19A99303P DESIGN THINKING AND PRODUCT INNOVATION LAB

Course Objectives:

- To develop products/models by 3D printing.
- To design measuring devices for temperature, pressure, humidity, water level, smart lighting.
- To design pneumatic and hydraulic circuits.

List of Experiments

1. 3D Printing
 - a. To develop a CAD model and simulate in CAE environment.
 - b. To develop tooling and make a physical prototype (Two Exercises).
2. To design a device for measurement of Temperature/ pressure.
3. To design a device for measurement of Humidity.
4. To design a device for Water Level Indicator.
5. To design a Smart Lighting system.
6. To design Automatic Car Wiper/ safety issues in Automobiles.
7. Design of simple pneumatic and hydraulic circuits using basic components.
8. Design of pneumatic circuit for speed control of double acting cylinders.
9. Design a hydraulic circuit by using Flow Control Valves for simple application.
10. Design and Simulation of a Hydraulic Shaper.
11. Design and Simulation of a Hydro Electric Circuit for simple application.

Course Outcomes:

The student is able to

- To develop 3D models using 3D printing
- To design the system with measuring devices
- Design hydraulic / pneumatic circuits

19A03301P MANUFACTURING PROCESSES LAB

Course Objectives:

- Acquire practical knowledge on Metal Casting, Welding, Press Working and unconventional machining Processes.

1. METAL CASTING

- Gating Design and pouring time and solidification time calculations.
- Sand Properties Testing – Exercise for Strength and Permeability.
- Molding, Melting and Casting for ferrous/ non ferrous materials.

2. WELDING

- TIG Welding.
- MIG Welding.
- Friction stir welding
- Any other Special Welding Processes.

3. MECHANICAL PRESS WORKING

- Press Tool: Blanking and Piercing operation with Simple, Compound and Combination dies.
- Closed die forging, Deep Drawing and Extrusion operations.

4. UN CONVENTIONAL MANUFACTUNRING PROCESSES

- Electro Discharge Machining(EDM)/ Wire cut EDM
- Plasma arc cutting / Abrasive jet machining (AJM)
- Additive manufacturing with reverse engineering

Course Outcomes:

At the end of the lab, the student will be able to

- Fabricate different types of components using various manufacturing techniques. (L6)
- Adapt unconventional manufacturing methods. (L6)

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19A03303P MATERIAL SCIENCE & ENGINEERING LAB

Course Objectives:

- To understand microstructure and hardness of engineering materials.
- To explain grain boundaries and grain sizes of different engineering materials.

List of Experiments:

1. Study of microstructure of pure metals – Iron, copper and aluminum.
2. Study of microstructure of low carbon steel, mild steel and high carbon steel.
3. Study of microstructure of cast irons.
4. Study of microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and their alloys.
5. Study hardenability of steels by Jominy End Quench Test.
6. Study of microstructure of heat treated steels.
7. Find hardness of various untreated and treated steels.
8. Study of microstructure of ceramics, polymeric materials.
9. Study of microstructure of super alloy and nano-materials.
10. Find the hardness of ceramics, super alloys, nano-materials and polymeric materials (one sample on each)

Course Outcomes:

The student is able to

- Identify various microstructures of ferrous and non-ferrous metals and alloys. (L3)
- Visualize grains and grain boundaries. (L3)
- Importance of hardening of steels. (L2)
- Evaluate hardness of treated and untreated steels. (L4)

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19A99301 ENVIRONMENTAL SCIENCE

Course Objectives:

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers.

UNIT – I

Multidisciplinary Nature Of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

Unit Outcomes

- To know the importance of public awareness
- To know about the various resources

UNIT – II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

- a. Forest ecosystem.
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity And Its Conservation : Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Course Outcomes:

- To know about various eco systems and their characteristics
- To know about the biodiversity and its conservation

UNIT – III

Environmental Pollution: Definition, Cause, effects and control measures of :

- a. Air Pollution.
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

Solid Waste Management : Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

Course Outcomes:

- To know about the various sources of pollution.
- To know about the various sources of solid waste and preventive measures.
- To know about the different types of disasters and their managerial measures.

UNIT – IV

Social Issues And The Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act –

Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

Course Outcomes:

- To know about the social issues related to environment and their protection acts.
- To know about the various sources of conservation of natural resources.
- To know about the wild life protection and forest conservation acts.

UNIT – V

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

Unit Outcomes:

- To know about the population explosion and family welfare programmes.
- To identify the natural assets and related case studies.

Course Outcomes:

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

- Grasp multidisciplinary nature of environmental studies and various renewable and nonrenewable resources.
- Understand flow and bio-geo- chemical cycles and ecological pyramids.
- Understand various causes of pollution and solid waste management and related preventive measures.
- About the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.
- Casus of population explosion, value education and welfare programmes.

TEXT BOOKS:

1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, "Environmental Studies", Pearson education
3. S.Azeem Unnisa, "Environmental Studies" Academic Publishing Company
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", Scitech Publications (India), Pvt. Ltd.

REFERENCES:

1. Deeksha Dave and E.Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice hall of India Private limited
5. G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.

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B.Tech – II-II Sem

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19A54304 NUMERICAL METHODS AND PROBABILITY THEORY

(Common to EEE, MECH)

Course Objective:

This course aims at providing the student with the knowledge on

- Various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations.
- The theory of Probability and random variables.

Unit-I: Solution of Algebraic & Transcendental Equations:

Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method
System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

Unit Outcomes:

Students will be able to

- Calculate the roots of equation using Bisection method and Iterative method.
- Calculate the roots of equation using Regula falsi method and Newton Raphson method.
- Solve the system of algebraic equations using Gauss Jordan method and Gauss Siedal method.

Unit-II: Interpolation

Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.

Unit Outcomes:

Students will be able to

- Understand the concept of interpolation.
- Derive interpolating polynomial using Newton's forward and backward formulae.
- Derive interpolating polynomial using Lagrange's formulae.
- Derive interpolating polynomial using Gauss forward and backward formulae.

Unit-III: Numerical Integration & Solution of Initial value problems to Ordinary differential equations

Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule
Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

Unit Outcomes:

Students will be able to

- Solve integral equations using Simpson's 1/3 and Simpson's 3/8 rule.
- Solve integral equations using Trapezoidal rule.
- Solve initial value problems to ordinary differential equations using Taylor's method.
- Solve initial value problems to ordinary differential equations using Euler's method and Runge Kutta methods.

Unit-IV: Probability theory:

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.

Unit Outcomes:

Students will be able to

- Understand the concept of Probability.
- Solve problems on probability using addition law and multiplication law.
- Understand Random variables and probability mass and density functions.
- Understand statistical constants of random variables.

Unit-V: Random variables & Distributions:

Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties-Uniform distribution-exponential distribution

Unit Outcomes:

Students will be able to

- Understand Probability distribution function.
- Solve problems on Binomial distribution.
- Solve problems on Poisson distribution.
- Solve problems on Normal distribution.

Course Outcomes:

After the completion of course, students will be able to

- Apply numerical methods to solve algebraic and transcendental equations
- Derive interpolating polynomials using interpolation formulae
- Solve differential and integral equations numerically
- Apply Probability theory to find the chances of happening of events.
- Understand various probability distributions and calculate their statistical constants.

Text Books:

1. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers.
2. Ronald E. Walpole "Probability and Statistics for Engineers and Scientists", ,PNIE.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India

Reference Books:

1. B.V.Ramana, "Higher Engineering Mathematics", Mc Graw Hill publishers.
2. Alan Jeffrey, "Advanced Engineering Mathematics", Elsevier.

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B.Tech – II-II Sem

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19A03401 THERMODYNAMICS

Course Objectives

- Familiarize concepts of heat, work, energy and governing rules for conversion of one form to other.
- Explain relationships between properties of matter and basic laws of thermodynamics.
- Teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
- Introduce the concept of available energy for maximum work conversion.
- Familiarize steam properties to understand working of steam power plants.
- Provide fundamental concepts of air standard cycles used in steam power plants, IC engines and gas turbines

UNIT I

10 hours

Introduction: Basic Concepts: Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics.

First law of Thermodynamics: Joule’s experiment - first law of thermodynamics, corollaries- perpetual motion machines of first kind, first law applied to non-flow and flow process- limitations of first law of thermodynamics.

Unit Outcomes

At the end of this Unit, the student will be able to

- Understand thermodynamic systems, properties and their importance in solving engineering problems. (L3)
- Make energy balance for closed systems and open systems. (L4)
- Solve simple thermodynamics problems. (L3)

UNIT II

8 hours

Second Law of Thermodynamics: Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility - Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency.

Unit Outcomes

At the end of this Unit, the student will be able to

- Apply second law of thermodynamics in design of heat engine, refrigerator and heat pump. (L3)
- Explain the efficiency of thermodynamic systems.(L2)
- Enumerate the causes for poor performance of thermodynamic systems. (L3)

UNIT III

8 hours

Entropy: Clausius inequality - Concept of Entropy- entropy equation for different processes and systems

Availability and Irreversibility: Definition of exergy and anergy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes and irreversibility.

Unit outcomes

At the end of this Unit, the student will be able to

- Apply entropy concepts to estimate the performance of systems. (L3)
- Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process. (L4)

UNIT IV

8 hours

Properties of Steam and use of Steam Tables: Pure Substances, P-V-T surfaces, T-s and h-s diagram, Mollier chart, dryness fraction, property tables, analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry.

Unit Outcomes

At the end of this Unit, the student will be able to

- Apply properties of steam to design steam systems. (L3)
- Examine steam systems using conservation equations. (L4)
- Evaluate the dryness fraction and performance of steam systems. (L4)

UNIT V

8 hours

Thermodynamic Relations: Maxwell relations, TdS equations, difference in heat capacities, ratio of heat capacities, Energy equation, Joule Thompson coefficient, Clausius-Clapeyron equation.

Air Standard Cycles: Otto, Diesel and dual cycles, P-V and T -S diagrams - description and efficiencies, mean effective pressures. Comparison of Otto, Diesel and dual cycles

Unit Outcomes

At the end of this Unit, the student will be able to

- Explain the importance of T-ds equations. (L3)
- Relate specific heats, internal energy, enthalpy and Joule-Thomson coefficient in standard form. (L3)
- Examine the importance of compression ratio. (L4)
- Explain the cycles on which internal combustion engines work. (L3)

Course Outcomes

After completing the course, the student will be able to

- Explain the importance of thermodynamic properties related to conversion of heat energy into work. (L3)
- Apply the laws of thermodynamics to boilers, heat pumps, refrigerators, heat engines, compressors and nozzles. (L3)
- Utilize steam properties to design steam based components. (L4)
- Compare thermodynamic relations and air standard cycles. (L4)

Text Book(s)

1. P.K.Nag, "Engineering Thermodynamics", 5th edition, Tata McGraw Hill, 2013.
2. Yunus A. Cengel, Michael A. Boles, "Thermodynamics", 7th edition, Tata McGraw Hill, 2011.

References

1. J.B.Jones and G.A.Hawkins, "Introduction to Thermodynamics", 2nd edition, John Wiley & Sons, 2012.
2. Moran, Michael J. and Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 3rd edition, Wiley, 2015
3. R.K. Rajput, S.Chand & Co., "Thermal Engineering", 6th edition, Laxmi publications, 2010.

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19A03402T MECHANICS OF MATERIALS

Course Objectives:

- Introduce the concepts of different stresses, strains and their relationships.
- Discuss the principal stresses and components of stress on different planes under different loads.
- Explain maximum shear force and bending moment of different beams under different loading conditions.
- Demonstrate bending stress and shear stress distribution of various cross section of beams and to predict the maximum slope deflection of beams.
- Impart strain energy due to axial, bending, and torsion loading, and to solve statically indeterminate problems using Castigliano's theorem.
- Focus on the stresses and deformations of the springs.
- Familiarize the Euler's concept of buckling in columns & struts.

UNIT I

10 Hrs.

Stresses and Strains:Types of stresses and strains, stress-strain relations, stress-strain diagram for ductile and other materials, axial loaded bars of uniform and varying cross section, compound bars, relation between three elastic moduli, thermal stresses.

Principal stresses and strains: Biaxial state of stress with and without shear - Mohr's Circle and analytical methods.

Unit outcomes:

After completing this unit, the student will be able to

- Determine stresses and deformations due to axial loads in simple members. (L3)
- Analyse stresses compound bars due to temperature raise. (L4)
- Correlate the elastic constants of materials.(L3)
- Construct the Mohr's circle for calculating principal stresses.(L3)
- Analyse principal stresses in biaxial state of loading. (L4)

UNIT II

10 Hrs.

Analysis of Beams: Types of beams and loads, shear force and bending moment diagram for cantilever, simply supported and overhanging beams for different types of loadings, point of contra flexure, relation between shearing force and bending moment.

Bending Stresses: Flexural equation, bending stress distribution and efficiency of various cross sections of beams. **Shear Stresses:** Shear stress distribution for different cross sections of beams.

Unit outcomes:

After completing this unit, the student will be able to

- Draw shear force and bending moment diagrams in beams subject to bending loading.(L3)
- Determine bending stresses in beams under different loading. (L4)
- Evaluate the maximum shear force and bending moment and their location in beams. (L4)
- Demonstrate the shear stress and bending moment distribution in different cross sections of beams.(L4)

UNIT III

8 Hrs.

Deflection of Beams: Differential equations of the deflection curve, Slope and deflection: using double integration method, Macaulay's method and Moment area method for simply supported, cantilever and overhanging beams.

Energy Methods: Strain energy, resilience. Deflection under single and several loads, Castigliano's theorem.

Unit outcomes:

After completing this unit, the student will be able to

- Compute the slope and deflection in beam under different loading.(L3)
- Distinguish various approaches for calculating slope and deflection. (L4)
- Explain the difference between strain energy, resilience, elastic strain energy and modulus of toughness. (L2)
- Apply the Castigliano's theorem for beams. (L3)

UNIT IV

8 Hrs.

Torsion of Circular Shafts: Theory of pure torsion, transmission of power in solid and hollow circular shafts, comparison of strengths of solid and hollow shafts, shafts in series and parallel, combined bending and torsion.

Springs: Deflection of closed and open coil helical springs under axial force and axial couple, Leaf springs.

Unit outcomes:

After completing this unit, the student will be able to

- Analyse circular shafts subjected to twisting couple. (L4)
- Determine stresses in shafts subjected to combined loads.(L4)
- Determine angle of twist in shafts. (L4)
- Determine stresses and deformations in helical and leaf springs. (L5)

UNIT V

8 Hrs.

Buckling of Columns: Analysis of columns to evaluate buckling loads with different boundary conditions, Euler's formula and its limitations, Rankine's formula, columns under eccentric load, columns under initial curvature.

Thin Cylinders: hoop and stresses, longitudinal, cylindrical and spherical shells subjected to internal pressure calculation of volumetric strain.

Unit outcomes:

After completing this unit, the student will be able to

- Determine buckling load in compressive members. (L4)
- Apply concepts of elastic stability of columns. (L3)
- Assess hoop and longitudinal stresses in thin cylinders. (L3)
- Calculate volumetric strain. (L3)

Course Outcomes:

After successful completion of this course student will be able to

- Apply the concepts of stress and strain to machine numbers. (L3)
- Determine, shear forces, and bending moments in beams. (L4)
- Find the slope and deflection in beams.(L4)
- Estimate the stress in machine members such as shafts and springs.(L4)
- Apply Castigliano's theorem to determine displacements in beams. (L3)
- Analyse columns for buckling loads.(L4)
- Estimate the stresses in thin cylinders due to internal pressure.(L3)

Text Books:

1. F.P. Beer, E.R. Johnston, Jr & John.T. DeWolf, "Mechanics of Materials", 7th edition, Tata McGraw-Hill, 2016.
2. SS Rattan, Strength of materials, 3rd edition, Tata McGraw-Hill, 2016.

References:

1. Timoshenko, "Strength of Materials Part-I& II", 3rd edition, CBS Publishers, 2004.
2. Popov, "Mechanics of Solids", 2nd edition, New Pearson Education, 2015.

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B.Tech – II-II Sem

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19A01407 FLUID MECHANICS AND HYDRAULIC MACHINERY

Course Objectives:

- To Introduce concepts of fluid statics and kinematics
- To impart the knowledge on minor losses in pipes
- To impart knowledge on power developed by hydraulic energy and hydro electric installations.
- To impart the knowledge on design of turbines
- To impart the knowledge on design of centrifugal pumps.

UNIT - I

FLUID STATICS : Dimensions and units: physical properties of fluids – specific gravity, porosity surface tension – vapor pressure and their influence on fluid motion – atmospheric gauge and vacuum pressure – measurement of pressure – Piezometer, U-tube differential manometers.

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

Fluid dynamics: surface and body forces – Euler’s and Bernoulli’s equations for flowing stream line, momentum equation and its application on force on pipe bend.

Unit Outcomes:

- To introduce the concepts stream line, path line, streak line etc.,
- To familiarize the concepts of rotational and irrotational flows

UNIT – II

CONDUIT FLOW: Reynold’s experiment – Darcy Weisbach equation – Minor losses in pipes – pipes in series and pipes in parallel – total energy line-hydraulic gradient line. Measurement of flow: pitot tube, venturimeter, and orifice meter, Flow nozzle, Turbine current meter.

Unit Outcomes:

- To introduce the concepts of pipes in series and parallel
- To familiarize the discharge measurements by using pitot tube, venturimeter etc.,

UNIT – III

TURBO MACHINERY : hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done efficiency, flow over radial vanes.

HYDROELECTRIC POWER STATIONS: Elements of hydro electric power station-types-concept of pumped storage plants-storage requirements.

Unit Outcomes:

- To impart the knowledge on effect of impact of jets on different types of vanes.
- To familiarize with the elements of hydroelectric installations.

UNIT – IV

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

PERFORMANCE OF HYDRAULIC TURBINES : Unit and specific quantities, characteristics governing of turbines, selection of type of turbine, cavitation, surge tank, hammer.

Unit Outcomes:

- To impart the knowledge on working principles of hydraulic turbines along with their efficiencies
- To evaluate the performance of different types of turbines.

UNIT – V

CENTRIFUGAL PUMPS : Classification, working, work done – manometric head – loss efficiencies – specific speed – pumps in series and parallel – performance characteristic curves, NPSH.

Unit Outcomes:

- To impart the knowledge on working principles of different pumps.
- To evaluate the performance of different types of pumps

Course Outcomes:

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

- Understand characteristics of laminar and turbulent flows.
- Understand the energy losses in different types of pipes.
- Identify the performance of different types of turbines
- Identify the performance of centrifugal pumps.

TEXT BOOKS :

1. “Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH”. Standard book house
2. Dr.R.K.Bansal, “Fluid Mechanics” Lakshmi Publications Pvt.Ltd.
3. D.Rama Durgaiah, “Fluid Mechanics and Machinery” New Age International.

REFERENCE BOOKS :

1. D.S. Kumar, “Fluid Mechanics and Fluid Power Engineering”, Kotaria & Sons
2. Banga & Sharma, “Hydraulic Machines”, Khanna Publishers.
3. James W.Dally, “Instrumentation for Engineering Measurements”, Wiley Riley, John Wiley & Sons Inc. 2004

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19A05406T INTERNET OF THINGS

Course Objectives:

- Introduce the fundamental concepts of IoT and physical computing
- Expose the student to a variety of embedded boards and IoT Platforms
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications.

UNIT I

Overview of IoT:

The Internet of Things: An Overview, The Flavor of the Internet of Things, The “Internet” of “Things”, The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things?

Design Principles for Connected Devices: Calm and Ambient Technology, Privacy, Web Thinking for Connected Devices, Affordances.

Prototyping: Sketching, Familiarity, Costs Vs Ease of Prototyping, Prototypes and Production, Open source Vs Close source, Tapping into the community.

Unit Outcomes:

After completing this Unit, students will be able to

- Explain IoT architecture. [L2]
- Interpret the design principles that govern connected devices [L2]
- Summarize the roles of various organizations for IoT [L2]
- Understand the significance of Prototyping [L2]

UNIT II

Embedded Devices:

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, Mobile phones and tablets, Plug Computing: Always-on Internet of Things

Unit Outcomes:

After completing this Unit, students will be able to

- Explain the basics of microcontrollers [L2]
- Outline the architecture of Arduino [L2]
- Develop simple applications using Arduino [L3]
- Outline the architecture of Raspberry Pi [L2]
- Develop simple applications using Raspberry Pi [L3]
- Select a platform for a particular embedded computing application [L3]

UNIT III

Communication in the IoT:

Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols

Prototyping Online Components:

Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols Protocol

Unit Outcomes:

After completing this Unit, students will be able to

- Interpret different protocols and compare them [L2]
- Select which protocol can be used for a specific application [L3]
- Utilize the Internet communication protocols for IoT applications [L3]
- Select IoT APIs for an application [L3]
- Design and develop a solution for a given application using APIs [L6]
- Test for errors in the application [L4]

UNIT IV

Business Models: A short history of business models, The business model canvas, Who is the business model for, Models, Funding an Internet of Things startup, Lean Startups.

Manufacturing: What are you producing, Designing kits, Designing printed circuit boards.

Unit Outcomes:

After completing this Unit, students will be able to

- Plan the business model [L6]
- Predict the market value [L5]
- Assemble the product [L6]

UNIT V

Manufacturing continued: Manufacturing printed circuit boards, Mass-producing the case and other fixtures, Certification, Costs, Scaling up software.

Ethics: Characterizing the Internet of Things, Privacy, Control, Environment, Solutions.

Unit Outcomes:

After completing this Unit, students will be able to

- Employ the manufacturing techniques [L4]
- Adapt the Ethics [L6]

Course outcomes:

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

- Choose the sensors and actuators for an IoT application (L1)
- Select protocols for a specific IoT application (L2)
- Utilize the cloud platform and APIs for IoT applications (L3)
- Experiment with embedded boards for creating IoT prototypes (L3)
- Design a solution for a given IoT application (L6)
- Establish a startup [L4]

Text Book:

1. Adrian McEwen, Hakim Cassimally – “Designing the Internet of Things”, Wiley Publications, 2012

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti – “Internet of Things”: A Hands-On Approach, Universities Press, 2014.
2. Pethuru Raj, Anupama C. Raman, “The Internet of Things, Enabling technologies and use cases” –CRC Press.

Reference sites:

1. <https://www.arduino.cc/>
2. <https://www.raspberrypi.org/>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech – II-II Sem

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19A03403 KINETICS OF MACHINERY

Course Objectives:

The Objectives of this course are to

- Introduce various basic mechanisms and applications
- Explain different exact and approximate straight line motion mechanisms
- Explain the concept of instantaneous centre
- Familiarize the concept of velocity and acceleration
- Describe cams and followers and their motions.
- Introduce the gears, gear trains and their applications.

UNIT – I

MECHANISMS AND MACHINES: Elements or Links – Classification – Rigid Link, flexible and fluid link. Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Mechanisms and machines – classification of mechanisms and machines – kinematic chain – inversion of mechanisms – inversions of quadric cycle chain – single and double slider crank chain. Mobility of mechanisms.

Unit Outcomes:

At the end of this unit, the student will be able to

- Contrast the difference between machine and structure
- Identify the different types of kinematic pairs and kinematic chains
- Identify the inversions of four bar mechanism

UNIT-II

Straight Line Motion Mechanisms- Exact and approximate, copied and generated types – Peaucellier, Hart and Scott Russel, Grasshopper, Watt, Tchebicheff and Robert Mechanisms. Pantograph.

Steering Mechanisms: Conditions for correct steering – Davis Steering gear, Ackermanns steering gear. Hooke's Joint (Universal coupling) -Single and double Hooke's joint — applications – Simple problems.

Unit Outcomes:

At the end of this unit, the student will be able to

- Identify the difference between exact and approximate mechanism
- Explain the working principles of different mechanisms
- Understand the functions of steering gear mechanisms
- Understand the difference between Davi's and Ackerman's steering gear mechanism

UNIT – III

KINEMATICS

Velocity and Acceleration Diagrams- Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method – Slider crank mechanism, four bar mechanism. Acceleration diagrams for simple mechanisms, Coriolis acceleration, determination of Coriolis component of acceleration. Klein's construction: Analysis of slider crank mechanism for displacement, velocity and acceleration of slider using analytical method

Instantaneous Centre Method: Instantaneous centre of rotation, centrode and axode – relative motion between two bodies – Three centres in-line theorem – Locating instantaneous centers for simple mechanisms and determination of angular velocity of points and links.

Unit Outcomes:

At the end of this unit, the student will be able to

- Draw the velocity and accelerations for different configurations.
- Find the velocity and accelerations of different points on and away from different links
- Understand the concept of instantaneous centers
- Find the velocity of different points on the links and angular velocities of different links using instantaneous centers method

UNIT – IV

GEARS: Higher pairs, toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Forms of tooth- cycloidal and involute profiles. Velocity of sliding – phenomena of interference – Methods to avoid interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact. Introduction to Helical, Bevel and Worm gearing.

GEAR TRAINS: Introduction –Types of gears – Simple, Compound, Reverted and Epicyclic gear trains, Train value – Methods of finding train value or velocity ratio – Tabular column method for Epicyclic gear trains. Torque in epicyclic gear trains. Differential gear of an automobile, Simple problems.

Unit Outcomes:

At the end of this unit, the student will be able to

- Understand the phenomenon of interference
- Find the relative merits and demerits of different tooth profiles
- Understand principle of operation of different gears trains for different purpose
- Find velocity ratio and torques for different gear trains

UNIT – V

CAMS: Definitions of cam and follower – uses – Types of followers and cams – Terminology. Types of follower motion - Uniform velocity, Simple harmonic motion, Cycloidal and uniform acceleration–and retardation Maximum velocity and maximum acceleration during outward and return strokes. Drawing of cam profiles.

ANALYSIS OF MOTION OF FOLLOWERS: Tangent cam with roller follower – circular arc (Convex) cam with flat faced and roller follower.

Unit Outcomes:

At the end of this unit, the student will be able to

- Understand the cam terminology
- Draw the cam profile for different types of follower motion
- Find the velocity and acceleration of the follower for different types of follower motions

Course outcomes:

At the end of the course student will able to:

- An understanding of concepts of different of mechanism with lower pairs and higher pairs.
- Gain the knowledge of different types of straight line motion mechanism and steering gear mechanisms.
- Obtain an in depth knowledge of finding displacement, velocity and acceleration of different points on different mechanisms using different methods(relative velocity,Instantaneous methods).
- Acquire the knowledge on different gear profiles and calculating the different parameters of gears.
- Gain the knowledge in designing of gear trains for the required purpose.
- Design and analyze different cam profile for different types of followers.

TEXT BOOKS :

1. S.S. Rattan, "Theory of Machines", Tata McGraw Hill Publishers.
2. J.E. Shiegley, "The Theory of Machines", McGraw Hill .

REFERENCES :

1. R.S. Khurmi & J.K. Gupta, "Theory of Machines", S. Chand Pub.
2. R.K.Bansal and J S Brar, "Theory of Machines", Laxmi Publications.
3. Thomas Bevan, "Theory of Machines", CBS.
4. J.S. Rao and R.V. Dukkanpati, "Mechanism and Machine Theory", New Age
5. R.L Norton , "Kinematics and dynamics of machinery", Tata McGraw Hill Publishers

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech – II-II Sem

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19A03404 COMPUTER AIDED MACHINE DRAWING

Course Objectives:

- Introduce conventional representations of material and machine components.
- Train to use software for 2D and 3D modeling.
- Familiarize with thread profiles, riveted, welded and key joints.
- Teach solid modeling of machine parts and their sections.
- Explain creation of 2D assembly drawings from 3D assemblies.
- Familiarize with limits, fits and tolerances in mating components.

The following contents are to be done by any 2D software package Conventional representation of materials and components:

Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.

Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted , double riveted double strap joints.

Welded joints: Lap joint and T joint with fillet, butt joint with conventions.

Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.

Shaft coupling, bushed pin-type flange coupling, universal coupling, Oldhams' coupling.

The following contents to be done by any 3D software package

Sectional views Creating solid models of complex machine parts and create sectional views.

Assembly drawings: (Any four of the following using solid model software)

Lathe tool post, tool head of shaping machine, tail stock, machine vice, gate valve, carburettor, piston, connecting rod, excentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling,

Manufacturing drawing:

Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

Course Outcomes:

After completion of this lab student will be able to

- Demonstrate the conventional representations of materials and machine components.
- Model riveted, welded and key joints using CAD system.
- Create solid models and sectional views of machine components.
- Generate solid models of machine parts and assemble them.
- Translate 3D assemblies into 2D drawings.
- Create manufacturing drawing with dimensional and geometric tolerances.

Text Books:

1. K.L.Narayana, P.Kannaiah, “A text book on Engineering Drawing”, SciTech Publications, 2014
2. “Software tools/packages”, Auto CAD, Solid works or equivalent.

Reference Books:

1. Cecil Jensen, Jay Helsel and Donald D.Voisinet, “Computer Aided Engineering Drawing”, Tata Mcgraw-Hill, NY, 2000.
2. James Barclay, Brain Griffiths, “Engineering Drawing for Manufacture”, Kogan Page Science, 2003.
3. N.D.Bhatt, “Machine Drawing”, Charotar, 50th edition, 2014.
4. K.L.Narayana, “Production Drawing”, NewAge International Publishers, 3rd edition, 2014

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech – II-II Sem

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19A03402P MECHANICS OF MATERIALS LABORATORY

Course Objectives:

- To conduct uni-axial tension test on Steel, Aluminium, Copper and Brass.
- To perform compression test on spring and wood.
- To determine elastic constants of materials using flexural and torsion tests.
- To find hardness of given metals.

List of Experiments:

1. Study the stress – strain relations of (a) Mild Steel b) Cast iron and (c) Tor Steel by conducting tension/compression test on U.T.M.
2. Study the stress – strain relation of (a) Copper and (b) Aluminium (c) other materials by conducting tension /compression test.
3. Find the compressive and shear strength of wood and shear strength of GI sheet by conducting relevant tests.
4. Find the Brinnell's and Vicker's hardness numbers of (a) Steel (b) Brass (c) Aluminium (d) Copper.
5. Determine the Modulus of rigidity (a) Solid shaft (b) Hollow shaft made of steel and aluminium.
6. Find the spring index and modulus of rigidity of the material of a spring by conducting compression and tensile tests.
7. Determine the Young's modulus of the material by conducting deflection test on a simply supported, propped cantilever and continuous beams.
8. Find impact strength of a given material by conducting a) Charpy test and b) Izod test
9. Determine buckling load in a compressive member made with steel and aluminium.
10. Determine the deflection in leaf spring with a single leaf and multiple leaves.

Course Outcomes:

On completion of this lab student will be able to

- Understand the stress-strain behaviour of different materials.
- Identify the difference between compression and tension testing.
- Evaluate the hardness of different materials.
- Correlate the elastic constants of the materials.
- Explain the relation between elastic constants and hardness of materials.

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B.Tech – II-II Sem

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19A99302 BIOLOGY FOR ENGINEERS

Course Objectives:

To provide basic understanding about life and life Process. Animal and plant systems. To understand what biomolecules are, their structures and functions. Application of certain biomolecules in Industry.

- Brief introduction about human physiology and bioengineering.
- To understand hereditary units, i.e. DNA (genes) and RNA and their synthesis in living organism.
- How biology Principles can be applied in our daily life using different technologies.
- Brief introduction to the production of transgenic microbes, Plants and animals.

Unit I: Introduction to Basic Biology

Cell as Basic unit of life, cell theory, Cell shapes, Cell structure, Cell cycle. Chromosomes. Prokaryotic and eukaryotic Cell. Plant Cell, Animal Cell, Plant tissues and Animal tissues, Brief introduction to five kingdoms of classification.

Unit Outcomes:

After completing this unit, the student will be able to

- Summarize the basis of life. (L1)
- Understand the difference between lower organisms (prokaryotes) from higher organisms (eukaryotes). (L2)
- Understand how organisms are classified. (L3)

Unit II: Introduction to Biomolecules

Carbohydrates, lipids, proteins, Vitamins and minerals, Nucleic acids (DNA and RNA) and their types. Enzymes, Enzyme application in Industry. Large scale production of enzymes by Fermentation.

Unit Outcomes:

After completing this unit, the student will be able to

- Understand what are biomolecules? their role in living cells, their structure, function and how they are produced. (L1)
- Interpret the relationship between the structure and function of nucleic acids. (L2)
- Summarize the applications of enzymes in industry. (L3)
- Understand what is fermentation and its applications of fermentation in industry. (L4)

Unit III: Human Physiology

Nutrition: Nutrients or food substances. Digestive system, Respiratory system, (aerobic and anaerobic Respiration). Respiratory organs, respiratory cycle. Excretory system.

Unit Outcomes:

After completing this unit, the student will be able to

- Understand what nutrients are (L1)
- Understand the mechanism and process of important human functions (L2 & L3)

Unit IV: Introduction to Molecular Biology and recombinant DNA Technology

Prokaryotic gene and Eukaryotic gene structure. DNA replication, Transcription and Translation. rDNA technology. Introduction to gene cloning.

Unit Outcomes:

After completing this unit, the student will be able to

- Understand and explain about gene structure and replication in prokaryotes and Eukaryotes (L1)
- How genetic material is replicated and also understands how RNA and proteins are synthesized. (L2)
- Understand about recombinant DNA technology and its application in different fields.(L3)
- Explain what is cloning. (L4)

Unit V: Application of Biology

Brief introduction to industrial Production of Enzymes, Pharmaceutical and therapeutic Proteins, Vaccines and antibodies. Basics of biosensors, biochips, Bio fuels, and Bio Engineering. Basics of Production of Transgenic plants and animals.

Unit Outcomes:

After completing this unit, the student will be able to Understand.

- How biology is applied for production of useful products for mankind.(L1)
- What are biosensors, biochips etc. (L2)
- Understand transgenic plants and animals and their production (L3)

Course Outcomes:

After studying the course, the student will be able to:

- Explain about cells and their structure and function. Different types of cells and basics for classification of living Organisms.
- Explain about biomolecules, their structure and function and their role in the living organisms. How biomolecules are useful in Industry.
- Briefly about human physiology.
- Explain about genetic material, DNA, genes and RNA how they replicate, pass and preserve vital information in living Organisms.
- Know about application of biological Principles in different technologies for the production of medicines and Pharmaceutical molecules through transgenic microbes, plants and animals.

Text books:

1. P.K.Gupta, Cell and Molecular Biology, 5th Edition, Rastogi Publications -
2. U. Satyanarayana. Biotechnology, Books & Allied Ltd 2017

Reference Books:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A Global Approach”, Pearson Education Ltd, 2018.
2. T Johnson, Biology for Engineers, CRC press, 2011
3. J.M. Walker and E.B. Gingold, Molecular Biology and Biotechnology 2nd ed.. Panima Publications. PP 434.
4. David Hames, Instant Notes in Biochemistry –2016
5. Phil Tunner, A. Mctennan, A. Bates & M. White, Instant Notes – Molecular Biology -- 2014.