**RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES BASAR**

**B.Tech in Mechanical Engineering**

**COURSE STRUCTURE& SYLLABUS**

**II Year – I Semester**

| S.No. | Subject Code | Subject Name | L | T | P/D | C |
|---|---|---|---|---|---|---|
| 1 | MA2102 | Mathematics –III | 3 | 1 | --- | 4 |
| 2 | ME2101 | Kinematics of Machinery | 3 | 1 | --- | 4 |
| 3 | ME2102 | Thermodynamics | 3 | 1 | --- | 4 |
| 4 | ME2103 | Mechanics of Solids | 3 | 1 | --- | 4 |
| 5 | ME2104 | Material Science & Metallurgy | 3 | 1 | --- | 4 |
| 6 | HS2101 | Soft Skills-I | 2 | --- | --- | 1 |
| 7 | ME2701 | Mechanics of Solids Lab | --- | --- | 3 | 2 |
| 8 | ME2702 | Material Science & Metallurgy Lab | --- | --- | 3 | 2 |
| 9 | ME2901 | Seminar-I | --- | --- | --- | 1 |
| | | **Total** | **17** | **5** | **6** | **26** |

**MA2102** **MATHEAMATICS-III**

**(For Mechanical Dept.)**

**EXTERNALS: 60MARKS** **L-T-P-C***

**INTERNALS: 40MARKS** **3-1-0-4**

**Objectives:**

* To understand the basic concept of the different Transforms
* To evaluate the integral equations by Laplace Transform,
* To know the Applications of Laplace Transforms. Fourier Transforms and Z-Transforms

**UNIT-I**

**Laplace Transform:** Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function. Differentiation and integration of transforms, convolution theorem,

**UNIT-II**

Inverse Laplace Transform, periodic functions. Evaluation of integrals by Laplace Transform. Solution of initial and boundary value problems and solving Differential Equations & Integral Equations.

**UNIT-III**

**Fourier Transform:** Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self-reciprocity of Fourier Transform, convolution theorem. Applications to boundary value problems.

**UNIT-IV**

**Z-Transform:** Definition of Z-Transform, Properties, inverse of the Z-Transforms. Finite difference equations,Definition of Mellin Transform, Properties of MellinTransforms

**UNIT-V:**

**Special Functions:**

Solution of ODE by Series,Legendre's Differential equation and Legendre's polynomial,Roudrigue's formula, Legendre's recurrence relation ,Generating function for Legendre's polynomial $P_n(x)$, orthogonal and orthonormal funtions, Orthogonal property of Legendre's polynomial $P_n(x)$

Bessel's differential equation, Bessel's functions, Recurrence relation for $J_n(x)$, Generating function for $J_n(x)$, Orthogonal property of Bessel's polynomial.

**Text Books**


1. Jain. R.K. Iyengar. S.R.K., Advanced Engineering Mathematics, 3rd Edition, Narosa.
2. Churchill. R.V. Brown. J.W., Fourier series and boundary value problems, McGraw. Hill


**Reference Books**


1. E. Kreyszig Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons (1999)
2. H.Dym and H.P Mc Kean, Fourier series and integrals, Academic press, Newyork (1972)


*L-T-P-C stands for number of lectures, tutorials, practices and credits

## CODE: ME2101 KINEMATICS OF MACHINERY

| | |
|---|---|
| Instruction | : 4 Hours/Week(3Theory+1Tutorial) |
| Duration of External Exam | : 3 Hours |
| Scheme of External Exam | : 60 Marks |
| Scheme of Internal Exam | : 40 Marks |
| Credits | : 4 |

**Objectives:**

- To understand the basic elements of machinery and their motion characteristics
- To know the kinematic properties of mechanisms and machines
- To understand basic machine elements
- To know classification and applications of cams, gears and gear-trains

**UNIT-I**

Definitions of link, pair, chain mechanism, degrees of freedom, Kutzbach's and Grubbler's criterion. Grashof's Law, Inversions of four bar mechanisms with all revolute joints, single and double slider crank mechanisms. Instantaneous Centre, Space Centrode and Body Centrode, Kennedy Theorem. Definitions and scope of Type, Number and Dimensional Synthesis. Pantograph and Geneva mechanisms. Ackerman and Davis steering gear mechanisms and Hooke's Joint. Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms.

**UNIT-II**

Analytical method to find velocities and accelerations in mechanisms. Velocities in mechanisms by instantaneous centre method, velocity and acceleration of mechanisms by using relative velocity method including Coriolis component of acceleration.

**UNIT- III**

Law of friction. Screw threads, Pivots, Collars. Clutches -Single and Multi plate, Cone and centrifugal clutches. Friction circle and friction axis of a link. Belt, Rope, Chain and drives.

**UNIT-IV**

**Brakes and Dynamometers:** Block or shoe, band, band and block, internal expanding shoe brakes. Rope brake and Belt transmission, Dynamometers. Types of Cams and followers, motion of the follower, follower displacement diagram, Cam profile for specified follower motion and Cams with specified contours.

**UNIT-V**

Theory of Gearing, Terminology and Definitions, Law of Gearing, Tooth profiles, Path of contact and Arc of contact. Interference, methods of avoiding interference. Contact Ratio. Introduction to Helical, Bevel and worm gears.

**Gear Trains:** Simple, Compound, Reverted and Epicyclic gear trains. Differential of an Automobile.

**Suggested Books:**

1. J. E. Shigley and John J. Uicker “Theory of Machines and Mechanisms”, Tata McGraw Hill, 2nd Edn., 1995.

2. Thomas Bevan, “Theory of Machines”, College Book Store (CBS) Publishers Ltd., 3rd Edn., 1985.

3. S.S. Rattan, “Theory of Machines”, Tata McGraw Hill, 3rd Edn., 1995.

4. J.S. Rao and R.V. Dukkipati, “Mechanisms and Machine Theory”, Wiley Eastern Limited, 1992.

5. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines, East West Press Pvt. Ltd, 2008

## CODE: ME2102 THERMODYNAMICS

| | |
|---|---|
| Instruction | :4Hours/Week(3 Theory+1 Tutorial) |
| Duration of External Exam | : 3 Hours |
| Scheme of External Exam | : 60 Marks |
| Scheme of Internal Exam | : 40 Marks |
| Credits | : 4 |

**Objectives:**

- To understand the basic concepts of thermal engineering.
- To study the concepts of thermodynamics useful in thermal design of devices/machines employed in industries/other applications.
- To lays the groundwork for subsequent studies in fields such as Fluid mechanics, Heat transfer, Refrigeration and Air Conditioning, Turbo machinery, Automobile Engineering and Gas Dynamics.
- To gain the knowledge to effectively apply thermodynamics in the practice of engineering.

**UNIT-I**

**Concepts of System**, **surroundings and Universe**. Types of systems. Classification of Properties- fundamental and secondary, intensive and extensive. Temperature Scales. International Practical Temperature Scale (IPTS). Zeroth law and thermodynamic equilibrium.
Ideal Gases- Equation of State. Specific Heats, Enthalpy, Internal energy, & Entropy. Real Gases-vander Waals Equation of State, Compressibility Factor. Types of thermodynamic processes and their representation of P-V and T-s plots. Types of cycles- Open and Closed

**UNIT-II**

**Forms of Energy**. Heat and Work Transfers. First law of thermodynamics. Energy conservation equation for a closed system. Calculation of Work Transfer, Heat Transfer, and Internal Energy changes.
**First Law analysis of flow processes**. Steady Flow Energy Equation and its applications. Calculation of Work Transfer, Heat Transfer, and Enthalpy changes. Thermodynamic analysis of flow through Nozzles, Diffusers, Turbines, Compressors, Throttling devices and Heat Exchangers. First law applied to Unsteady flow Processes. Calculation of Heat transfer during charging /evacuation of a Cylinder.

**UNIT-III**

**Carnot Cycle**- Efficiency of Carnot Cycle in terms of ratio or temperatures and heat transfers. Applications of Carnot cycle -Heat Engine, Refrigerator and Heat Pump.
Second Law of Thermodynamics: Statements of Second Law of thermodynamics. Equivalence of Kelvin-Planck and Clausius Statements. Carnot Theorems, Thermodynamic Temperature Scale, Clausius Inequality. Concept of Entropy. Reversible and Irreversible processes. Calculation of Entropy change during various thermodynamic processes. Principle of Increase of Entropy. Second law analysis of a control Volume. Concepts of Exergy and Anergy. Loss in available energy. Second law efficiency of Turbines and Compressors Thermodynamic analysis of Air Standard Cycles- Otto, Diesel, Dual and Joule/ Brayton.

**UNIT-IV**

**Pure Substances**. Concept of Phase Change. Graphical representation of thermodynamic processes on P-V, P-T, T-V, T-S, H-S, P-H and P-V-T diagrams. Thermodynamic relations involving Entropy, Enthalpy and Internal Energy. Maxwell's relations. Clapeyron equation.
Properties of Steam- Use of Steam Tables and Mollier diagram.
Power Plant Cycles-Carnot and Rankine Cycles and their representation on P-V, T-S and H-S diagrams. Evaluation of performance parameters–Efficiency, Work ratio, Specific Steam Consumption and Heat Rate.

**UNIT-V**

**Non reactive Ideal homogenous gas Mixtures**: Determination of properties of Mixture in terms of properties of individual components of the mixture. Gibbs Phase Rule.
Psychrometry. Moist Air Properties. Use of Psychrometric Chart and Tables.
Concept of Air-Conditioning. Heating, Cooling, Humidification and De-humidification and other psychrometric processes. Adiabatic Mixing of two Streams of Moist Air. Sensible heat factor and Bypass factor for heaters/coolers.
Introduction to summer and winter Air-Conditioning Processes with a brief overview on devices used in Air Conditioning.

**Suggested Reading:**

1. Yunus A Cengel and Michael A Boles, "*Thermodynamics-An Engineering Approach*", Tata Mc Graw Hill Publishing Company Ltd. ,6th Edn., Fifth Reprint, 2009.
2. Nag P.K, "*Engineering Thermodynamics'*: Tata McGraw Hill Publishing, 8th Edn, 3rd Reprint 2010.
3. Nag P.K, "*Basic & Applied Thermodynamics'*: Tata McGraw Hill Publishing, 8th Reprint 2006.
4. Richard E.Sonntag, C.Borgnakke, G.J Van Wylen, "Fundamentals of Thermodynamics': John Wiley & Sons, 7th Edn., 2009.
5. Rajput R K, " *Engineering Thermodynamics*" Laxmi Publications, 4th Edition, 2010

**REFERENCES :**

1. Fundamentals of Thermodynamics – Sonntag, Borgnakke and van wylen, John Wiley & sons (ASIA) Pte Ltd.
2. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles, TMH
3. Thermodynamics – J.P.Holman, McGrawHill
4. An introduction to Thermodynamics, YVC Rao, New Age
5. Engineering Thermodynamics – Jones & Dugan

## CODE: ME2103 MECHANICS OF SOLIDS

| | |
|---|---|
| Instruction | :4Hours/Week(3Theory + 1 Tutorial) |
| Duration of External Exam | : 3 Hours |
| Scheme of External Exam | : 60 Marks |
| Scheme of Internal Exam | : 40 Marks |
| Credits | : 4 |

**Objectives:**

- To understand the basic concept of stress and strains for different materials
- To know the mechanism of the development of shear force and bending moment in beams
- To know the theory of simple bending, direct & bending stress and distribution of shear stress
- To study the deflections and its applications
- To analyze and understand shear stress, torsional stress and spring applications

**Unit – I**

**Simple stresses and strains:** Types of stresses and strains. Hooks's Law, Stress- Strain curve for ductile materials, moduli of elasticity. Poisson's ratio, linear strain, volumetric strain, relations between elastic constants. Bars of varying sections, bars of uniform strength, compound bars and temperature stresses, change in length.

**Unit-II**

**Shear Force and Bending Moment:** Relation between intensity of loading. Shear force and bending moment, shear force and bending moment diagrams for cantilever and simply supported beams with and without overhanging for point loads, uniformly distributed loads, uniformly varying loads and couples.

**Compound Stresses:** Stresses on oblique planes, principle stresses and principle planes. Mohr circle of stress and ellipse o stress.

**Unit-III**

**Theory of simple bending:** Assumptions derivation of basic equation: $M/\square = \square/y = E/R$
Modulus of section, Moment of resistance, determination of flexural stresses.

**Direct and Bending Stresses:** Basic concepts, core of sections for rectangular, solid and hollow circular and I sections.

**Distribution of shear stress:** Equation of shear stress, distribution across rectangular, circular, diamond, T and I sections.

**Unit-IV**

**Deflections:** Deflections of cantilever and simply supported beams including overhanging beams for point loads and uniformly distributed loads by double integration and Maualay's method.

**Strain Energy:** Strain energy in bars due to gradually applied loads, sudden loads, impact loads and shock loads.

**Unit-V**

**Torsion**-Theory of pure torsion- derivation of basic equation **T/J = y/R = G□/L** and hollow circular shafts, strain energy- Transmission of power, combined bending and torsion.

**Springs:** Close and open coiled helical springs subjected to axial loads and axial couples, strain energy in springs- carriage springs.

**Suggested Readings:**


1. D.S. Prakash Rao, Strength of Materials – A practical Approach, Universities Press, 1999.
2. R.K. Rajput, Strenght of Materials, S. Chand & Co., 2003.
3. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Publishers, Delhi, 2000.
4. Ferdinand P Beer et.al., Mechanics of Materials, Tata McGraw-Hill, 2004.
5. G.H. Ryder, Strength of Materials, Third Edition in SI units, Macmillan Indian Limited, Delhi, 2002.
6. S. Ramamrutham, Strength of Materials, Dhanpat Rai & Sons, 1993.
7. S.S. Bhavakatti, Strength of Materials, Vikas Publications, 2003.


**REFERENCES :**


1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol-III, by S.B.Junnarkar.
4. Strength of Materials by S.Timshenko
5. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman.

## CODE: ME2104 MATERIAL SCIENCE AND METALLURGY

| | |
|---|---|
| Instruction | :4 Hours/Week(3 Theory+1 Tutorial) |
| Duration of External Exam | : 3 Hours |
| Scheme of External Exam | : 60 Marks |
| Scheme of Internal Exam | : 40 Marks |
| Credits | : 4 |

**Objectives:**

- To understand the basic concepts of metallurgy of metals and alloys
- To know the fundamentals of fatigue, fracture, creep and diffusion
- To familiarize the principles of heat treatment

**Unit I:**

**Introduction:**Why study properties of materials, classification of materials, advanced material, future and modern materials.Atomic structure, inter atomic bonding and structure of crystalline solids.Influence on properties of materials,

**Structures of crystalline solids** : Crystal structures, crystallography, planes and directions. Determination of crystal structures by X ray diffraction methods.

**Imperfections in solids:**Solidification process and Imperfections point, line, surface and volume defects,characteristics of dislocations, interactions between dislocations.

**Unit II:**

**Deformation behaviors of materials**: Elastic deformation, plastic deformation,and time dependent deformation processes, failure of materials, Fracture, fatigue and creepconcepts and their significance.

**Mechanical Properties of material and testing** :Stress vs Straingraph,Tension test, Compression Test, hardness tests Brinnells,Vickers, Rockwell, Superficial hardness test and micro hardness testing. Impact testing, creep test,fatigue test and fracture of materials and testing.

**Unit III:**

**Phase Diagrams**:Gibbs phase rule, cooling curves for pure metals and alloy, construction of phase diagrams, Equilibrium of phase diagrams (isomorphous, eutectic, partial eutectic and layered system) , lever and tie line rule, phase transformation, iron carbon phase diagram, different phases and applications in iron carbon system.

**Unit IV:**

**Heat treatment and TTT curves:**Transformation rate effects and TTT and CCT diagrams, microstructure and property changes in iron-carbon diagrams.Heat treatment of steel, Annealing, Normalizing, Hardening, Tempering, Austempering and Martempering of steels.Surface hardening of steels.Carburizing, Nitriding, Cyaniding, Flame and induction hardening methods.

**Unit V:**

**Cast Irons and Steels :** Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, tool and die steels.

**TEXT BOOKS :**

1. Introduction to Physical Metallurgy, Sidney H. Avener.
2. Essential of Materials Science and Engineering, Donald R.Askeland, Thomson.

**REFERENCES:**

1. Material Science and Metallurgy, kodgire.
2. Science of Engineering Materials, Agarwal
3. Materials Science and Engineering, William and collister.
4. Elements of Material science, V. Rahghavan
5. Engineering Materials and Their Applications – R. A Flinn and P K Trojan, Jaico Books.
6. Engineering materials and metallurgy, R.K.Rajput, S.Chand.

## HS2101 SOFT SKILLS-I

**Externals: 60** **L-T-P-C***
**Internals: 40** **2-0-0-1**

**Objectives:**

- To implement practically the skills needed for employment.
- To deal with the society in an acceptable way.
- To make them competent to attempt and qualify in various tests.
- To make them proficient in using vocabulary in various situations.

**UNIT-I**

**Vocabulary Building** – Teaching Root words – Word association - How to talk about Personality Type - How to talk about Doctors - How to talk about Various Practitioners - How to talk about Science and Scientists - How to talk about various Speech Habits - How to insult your enemies - How to flatter your friends - How to talk about a variety of personal characteristics - How to talk about actions

**UNIT-II**

**Common Errors in English**

**UNIT-III**

**Twenty -four seven** - L for gist - NDTV debates - L for specific information - Ted Talks - L for detail - Devils' Advocate - **Picture perception** – Describing people, paintings, cartoons etc.

**UNIT-IV**

**Read between the lines –** R for Pleasure - Reading Newspaper - Movie Reviews - **R for Specific information –** Essays - Textbooks

**UNIT-V**

**Now you are talking** - Giving Opinions - Stating Facts - Agree and disagree - Decisions and Intentions - Raising Questions - Giving and receiving effective feedback

**UNIT –VI**

**Writing Dailogue**

**Suggested References:**

1. Word Power Made Easy
2. Ted Talks
3. NDTV Talks
4. Newspapers ( The Hindu, Times of India)

## CODE: ME2701 MECHANICS OF SOLIDS LAB

| | |
|---|---|
| Instruction | : 3 Hours/Week (3 Practical) |
| Duration of External Exam | : 3 Hours |
| Scheme of External Exam | : 60 Marks |
| Scheme of Internal Exam | : 40 Marks |
| Credits | : 2 |

**Objectives:**

- To know and understand the experiments on various materials to assess their behavior/limitations.
- To know the brittle and ductile material failure patterns etc., by conducting experiments
- To understand shear force, bending moment and deflections for different types of beams
- To know the rigidity modulus by conducting spring and torsion test.

**Cycle – I**

1. Direct tension test on metal bars
2. Young's modulus of metal specimen
3. Harness tests: Brinell and Rockwell
4. Compression test on bricks
5. Impact test
6. Shear force and bending moment tests

**Cycle – II**

7. Spring test
8. Torsion test
9. Bending test on simply supported beam
10. Bending test on continuous beam
11. Bending test on fixed beam
12. Curved beam

***Note:*** *At least ten experiments should be conducted in the Semester*

1. To carry out tension shear test of material supplied
2. To carry out charpy test, Tension impact test, Izod test.
3. To study the stress strain tension characteristics of metals by using UTM
4. To study the stress strain compression characteristics of metals by using UTM
5. To find out the modulus of elasticity of the specimen supplied and to verify the Maxwells theorem
6. To determine the hardness using different hardness testing machines: Brinnels, Vickers and Rockwell's.
7. To calibrate the given proving ring by applying compressive force by U.T.M
8. Deflection test on beams using U.T.M

## CODE: ME2702 MATERIAL SCIENCE AND METALLURGY LAB

| | |
|---|---|
| Instruction | : 3 Hours/Week (3 Practical) |
| Duration of External Exam | : 3 Hours |
| Scheme of External Exam | : 60 Marks |
| Scheme of Internal Exam | : 40 Marks |
| Credits | : 2 |

**Objectives:**

- To familiarize the procedure for specimen preparation
- To prepare different metal specimen for identification
- To study the microstructure of metals and alloys
- To understand the heat treatment procedures
- To study the microstructure after heat treatment

**List of Experiments:**

1. Study of: Metallurgical Microscope

Iron-Iron Carbide diagram
Procedure for specimen preparation

2. Metallographic Study of Pure Iron
3. Metallographic Study of Low carbon steel
4. Metallographic Study of Medium carbon steel
5. Metallographic Study of Eutectoid steel
6. Metallographic Study of Hyper Eutectoid steel
7. Metallographic Study of Wrought iron
8. Metallographic Study of Grey cast iron
9. Metallographic Study of White cast iron
10. Metallographic Study of Black heart Malleable cast iron
11. Metallographic Study of white heart Malleable cast iron
12. Metallographic Study of Brass and Bronze
13. Study of microstructure after hardening, normalizing and annealing of steel specimen.

***Note:*** *At least ten experiments should be conducted in the Semester*

1. Metallographic Preparation and microstructural study of pure metals (Fe, Cu, Al)
2. Metallographic Preparation and microstructural study of mild steel, low-carbon steel and high carbon steel

3. Microstructural study of Cast Iron
4. Microstructural study of Heat treated Steels
5. Jominy End quench test (hardness of the samples to be tested in "Mechanics of Solid Lab)
6. Melting of aluminum ( or its alloy) and casting in sand molds, chilled sand molds and steel molds, and microstructural study of the samples ( Hardness study of the samples will be done in " Mechanics of Solids Lab )

**CODE: ME2901 SEMINAR-I**

Scheme of Internal Exam : 25 Marks
Credits : 1

**Objectives:**
Objective of the project seminar is to actively involve the students in preparation of the final year project with regard to following components:

- Problem definition and specification
- Literature survey, familiarity with research journals
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of graphs, bar (activity) charts and analyzing the results.
- Presentation - oral and written.

The evaluation is purely internal and will be conducted as follows:

| | |
|---|---|
| Preliminary Report on progress of the work and viva | 05 marks |
| Final report | 05 marks |
| Presentation and Defence before a departmental committee consisting of Head, a senior faculty and supervisor | 15 marks |

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