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Institute of Engineering & Science, Indore
Mechanical Engineering,
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Scheme

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	BSC-MA04	BSC	Program Specific Mathematics	60	30	10	-	-	100	2	1	-	3
2.	PCC-ME01	PCC	Material Science	60	30	10			100	3	-	-	3
3.	PCC-ME02	PCC	Manufacturing Processes	60	30	10			100	3	-	-	3
4.	PCC-ME03	PCC	Strength of Materials	60	30	10			100	2	1	-	3
5.	PCC-ME04	PCC	Thermodynamics	60	30	10			100	2	1	-	3
6.	HSMC-HS03	HSMC	Innovation & Creativity	-	-	-	-	100	100	1	-	-	1
7.	LC-ME01(P)	LC	Material Science Laboratory	-	-	-	60	40	100	-	-	2	1
8.	LC-ME03(P)	LC	Strength of Materials Laboratory	-	-	-	60	40	100	-	-	2	1
9.	LC-ME04(P)	LC	Thermodynamics Laboratory				60	40	100	-	-	2	1
10	SBC-ME02(P)	SBC	Manufacturing Practice Laboratory	-	-	-	60	40	100	-	-	2	1
11	LLC-02	LLC	Liberal Learning Course -II	-	-	-	-	100	100	-	-	2	1
12.	MLC01	MLC	Professional Laws, Ethics, Gender, Human Values and Harmony	60	40	-	-	-	100	1	-	-	Audit
Total Academic Engagements and Credits										**14**	**3**	**10**	**21**
Total				**360**	**210**	**50**	**240**	**360**	**1200**	**15**	**2**	**8**	**19**

*MST: Minimum of two mid semester tests to be conducted.

L: Lecture T: Tutorial P: Practical

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Syllabus

BSC-MA04	Program Specific Mathematics(**Numerical Methods and Laplace Transform)**	**02L;2T;0P (03 Hrs)**	**Credits: 03**

Course Objective: The main objective of this course is to teach mathematically modeling of a physical system, Identify appropriate numerical method to find solutions of simulated physical system and apply the numerical methods to solve Civil Engineering problems.

Module-1: Introduction: Basic concepts of Numerical Methods: Mathematical modeling; accuracy and precision; errors analysis. **(8 Hrs)**

Module-2 Roots of Equations: Graphical Methods; Bisection Method; Newton-Raphson Method; Multiple Roots. **(10 Hrs)**

Module-3: **Curve Fitting**: Least Square Regressions, Interpolation by Newton's Formulae, Lagrange Interpolating Polynomials, Spline Interpolation. **(8 Hrs)**

Module-4 Ordinary Differential Equations: Taylor's Series method; Euler's method; Modified Euler's method, Runge- Kutta method (Second and Fourth Order) **(10 Hrs)**

Module-5 Laplace Transform: Introduction of Laplace Transform, Laplace Transform of elementary functions, properties of Laplace Transform, Change of scale property, second shifting property, Laplace transform of the derivative, Inverse Laplace transform & its properties, Convolution theorem, Applications of L.T. to solve the ordinary differential equations **(12 Hrs)**

Course Outcomes: At the end of this course student will be able to
CO1: Understand basic concepts of Numerical Methods.

CO2: Identify appropriate numerical method to find solutions of simulated physical system

CO3: Evaluate curve fitting, Least Square Regressions

CO4: Recognize and apply the concept of Ordinary Differential Equations

CO5: Find Laplace transformation

Reference Books:

1. Chapra, Cannale, "Numerical Methods for Engineers", 6th edition, McGraw-Hill Int.,
2 Sastry S. S., "Introductory Methods of Numerical Analysis", 5th edition, Prentice Hall of India Delhi
3 N Krishna Raju Ku Muthu, Numerical Methods For Engineering Problems, 2nd edition, Macmillan
4 Children's Books Amos Gilat, "Numerical Methods for Engineers and Scientists", 3rd Edition, Wiley International, 2014
5. Ascher, U.M. and Greif, C., "A First Course in the Numerical Methods", SIAM Publication, 2011.
6 Khoury, Richard, Harder, Douglas Wilhelm, "Numerical Methods and Modelling for Engineering",

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PCC-ME01	**Material Science**	**3L: 0T (03hrs)**	**Credits:03**

Prerequisite(s): Basics of organic chemistry

Course Objective's:

- Materials engineering is concerned with the use of fundamental and applied knowledge of materials.
- To know the change of crystal structure of different materials and its application.
- To understand different materials and its uses in different application.

Course Content:

Module 1 **(10 hrs)**

Atomic Structure and Crystallography: Classification of Engineering materials, Structure of Atoms, types of bond in solids i.e, ionic bond, covalent bond, metallic bond, molecular or Van der Wall's bond, Crystal structure and crystal lattice, calculation of number of atoms per unit cell, atomic packing factor(APF) and Atomic Radius in SC, BCC, FCC and HCP space lattice,

Module 2 **(08 hrs)**

Mechanical properties of engineering materials and manufacturing of Iron and Steel : tensile strength, compressive strength, ductility, malleability, hardness, toughness, brittleness, impact strength, fatigue, creep resistance, stress-strain diagrams for engineering materials. Description of the manufacturing processes for iron and steel making Classification, composition properties and uses of steels, mild steel and alloy steels.

Module 3 **(08 hrs)**

Plastic Deformation of metals and Fracture Mechanics: crystal defects, diffusion of solid, Dislocation, Edge dislocation, Screw dislocations, Slip planes, ductile fracture, brittle fracture, ductile to brittle transition, crack propagation, Griffith Theory, fatigue fracture mechanics.

Module 4 **(09 hrs)**

Equilibrium Diagram, Alloy formation and Heat Treatment of steels and alloys : Phase diagrams, Allotropy structure of alloys, Lever rule, phase rule, Cooling curves, Iron carbide equilibrium diagram, TTT diagram, Heat treatment of steels and alloys i.e., annealing, normalizing, hardening, tempering, carburizing, nitriding and cyaniding.

Module 5 **(07 hrs)**

Destructive and Non- Destructive Testing: Tensile test, Compression test, shear test, bend test, Different types of Hardness tests, Impact tests, Fatigue tests, Hardenability test, NDT Methods – LPI, MPI , Ultrasonic test, Radiography test, Eddy current test.

Course Outcomes:

After completion of this course, the students are able to:

1. Appreciate various crystal structure, miller indices and dislocations.
2. Understand the changes in phases of alloys, cooling curves and heat treatment of metals changes their properties.
3. Perform of various methods available for testing of metals destructively and non-destructively.
4. Understand fracture mechanics and powder metallurgy.
5. Know about various modern materials and significance

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List of Text Book:

1. William D. Calister “Materials Science and Engineering”, “Wiley”, “Second edition”.
2. V Raghvan “Materials Science and Engineering” “PHI Publication” “Sixth Edition”.
3. G.E. Dieter “Mechanical metallurgy” “TMH Publication” “Third Edition”.

List of Reference Book:

1. William F Smith “Materials Science and Engineering” TMH publication “Fifth Edition”.
2. U C Jindal, Materials Science and metallurgy” Pearson Publication” First Edition”
3. Prashant Kumar “Elements of Fracture Mechanics” TMH Publication” First edition”
4. T Pradeep “A text book of Nanoscience and nanotechnology” TMH Publication” First Edition”

List of Experiment:

1. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test
2. Preparation of specimen for Metallographic examination and Metallographic study of given specimen through metallurgical microscope.
3. To study hardness as a function of quench rate and investigate the hardenability of steels by Jominy End Quench Apparatus.
4. To gain experience with and understanding of the types, advantages and applications of various NDT methods. To be able to choose the best NDT method for a given part and perform Test on UFD machine.
5. To determine carbon and sulphur contents in iron and steel by Strohlein’s Apparatus.
6. Study of Annealing process of heat treatment and its effect on microstructure and Mechanical Properties.

Virtual Lab Experiment:

1. Material Response to Microstructural, Mechanical, Thermal and Biological Stimuli Lab
2. Microstructural analysis of Stainless Steel
3. Comparison between Mild Steel and Grey Cast Iron
4. Severity of Quenching

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PCC-ME02	Manufacturing Processes	3L: 0T: 0P (03 hrs)	Credits:03

Pre requisite(s): Nil

Course Objective's:

- Get the knowledge of Foundry
- Know various Joining process
- Understand the Forging and Rolling process
- Understand the sheet metal process
- Understand the machine tools, mechanisms and accessories

Module 1 **(10 hrs)**

Foundry –Pattern Making, Moulding and Casting: Types of patterns, Pattern and pattern making, pattern allowances; pattern design considerations, core, core boxes .Types of casting process .Molding and Foundry core sands and their properties, runners, risers, solidification, defects and elimination, molding machines, centrifugal casting, dye casting, shell molding; Lost wax molding; continuous casting gating and gating design. Cupola, electric arc and induction furnaces description and operation.

Module 2 **(10hrs)**

Joining Process: Types of welding ,Gas welding method, flames, gas cutting, Electric arc welding, AC and DC welding machines and their characteristics, flux, electrodes, submerged arc welding, TIG & MIG welding; pressure welding; electric resistance welding spot, seam and butt welding; EBW and LASER welding. Thermit chemical welding; brazing and soldering, welding defects & remedies, safety precautions. Printed circuit board design.

Module 3 **(08 hrs)**

Forging and Rolling: Types of forging operations theory and application of forging processes description; drop and horizontal forging machines. Forging design, Types of Rolling operations, General description of machines and process; rolling of structural section plates and sheets; hot and cold rolling techniques.

Module 4 **(08 hrs)**

Press Working: Description and operation of processes, process of shearing, punching, piercing, blanking, trimming, perfecting, notching, lancing, embossing, coining, bending, forging and drawing; press, tool dies, auxiliary equipment, safety devices, stock feeders, scrap cutters, forces, pressure and power requirements .

Module 5 **(08 hrs)**

Metal Machining: Basics of Lathe machines, operations & components, working principle of shaper & planner, Introduction to milling, grinding and drilling machines. Introduction to additive manufacturing.

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Course Outcomes:

After completion of this course, the students should be able to:

1. Develop the basic knowledge of Foundry
2. Understands the knowledge of joining process
3. Understand the Forging and Rolling process.
4. Identify the sheet metal Process
5. Develop the basic knowledge of machine and manufacturing processes.

List of Text Book:

1. Raghuvanshi; Workshop Technology; Dhanpat Rai.
2. P.N Rao : Production technology Volume I&II : TMH
3. Anderson and Tetro; Shop Theory; Mc Graw Hills

List of References Book:

1. Kaushish JP; Manufacturing Processes; PHI Learning.
2. Kalpakjian Producting Engineering PEARSON Education
3. Chapman; Workshop Technology
4. Philip F Ostwald ; Manufacturing Process & systems : John Wiley

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PCC-ME03	**Strength of Materials**	**2L:1T:0P (03 hrs)**	**Credits:03**

Pre requisite(s): Engineering Mechanics

Course Objective's:

- To establish an understanding of the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behavior.
- To provide students with exposure to the systematic methods for solving engineering problems in solid mechanics.
- To discuss the basic mechanical principles underlying modern approaches for design of various types of structural members subjected to axial load, torsion, bending, transverse shear, and combined loading.

Module 1 **(10 hrs)**

Stress and Strain: stresses in members of a structure, axial loading, normal stress, shear stress, analysis of simple structures, stepped rods, members in series and parallel: stress strain diagram, Hooke's law, stress due to temperature, Poisson's ratio, Bulk modulus, shear strain, relation among elastic constants, residual stress, fiber reinforced composite materials, strain energy under axial loads and stresses due to impact of falling weights.

Module 2 **(09 hrs)**

Transformation of Stress and Strain, principal stresses, normal and shear stress, Mohr's circle and its application to two and three dimensional analysis. Thin Pressure vessel, hoop stress, longitudinal stress and radial stress.

Module 3 **(11 hrs)**

Bending: Pure bending, symmetric member, deformation and stress, bending of composite sections, eccentric axial loading, shear force and BM diagram, relationship among load, shear and BM, shear stresses in beams, strain energy in bending, deflection of beams, equation of elastic curve, Macaulay's method and Area moment method for deflection of beams.

Module 4 **(08 hrs)**

Torsion in Shafts: Tensional stresses in shafts, deformation in circular shaft, angle of twist, stepped and hollow transmission shafts, combined bending and torsion.

Module 5 **(10 hrs)**

Theories of Failures: maximum normal stress & shear stress theory; maximum normal and shear Strain energy theory, maximum distortion energy theory; application of theories to different materials and loading conditions.

Columns & Struts: Buckling of columns, Euler's formula for columns with different end conditions and Rankine's formula.

Course Outcomes:

After completion of this course, the students are able to:

1. Illustrate the deformation of material under load by various approaches.
2. Evaluate the principal stresses.

3. Analyze the deformations of beam within elastic limit against bending.
4. Analyze and identify the deformation of rotating element within elastic limit.
5. Apply and analyze various theories of failures for different materials and evaluate the stresses in columns under buckling.

List of Text Book:

1. Ramamurtham, Strength of Materials, Dhanpat Rai Publication
2. S. S. Rattan, Strength of Materials, Tata McGraw Hill Publication
3. R. K. Rajput, Strength of Materials, S. Chand Publication

List of Reference Book:

1. R. C. Hibbeler, Mechanics of Materials, Pearson Education
2. Sadhu Singh; Strength of Materials; Khanna Pub
3. Beer and Johnston, Mechanics of Material, Mc Graw Hill publication
4. J.B. Popov, Introduction to Mechanics of Solids, Prentice – Hall publication
5. F. L. Singer and Pytel, Strength of Material, Harper and Row publication

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PCC-ME04	Thermodynamics	2L:1T:0P (03hrs)	Credits:03

Pre requisite(s): Nil

Course Objective's:

- Apply conservation principles to evaluate the performance of thermodynamics systems and cycles.
- Analyze processes and cycles using the second law of thermodynamics to determine maximum efficiency and coefficient of performance.
- Evaluate thermodynamic properties of pure substances.

Course Content:

Module 1 **(08 hrs)**

Basic Concepts & First Law of Thermodynamics: Thermodynamics, Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics statement and significance, Heat and work transfer. First law of thermodynamics- Statement of first law of thermodynamics, first law applied to closed system, first law applied to a closed system undergoing a cycle, processes analysis of closed system, flow process, flow energy, steady flow process, Relations for flow processes, limitations of first law of thermodynamics.

Module 2 **(09 hrs)**

Second Law of Thermodynamics: heat engine, heat reservoir, Refrigerator, heat pump, COP, Available energy, Carnot's theorem, Carnot's cycle, efficiency of Carnot's cycle, statement of second law Reversible and irreversible processes, consequence of second law, Entropy, Entropy change for ideal gas, T-S diagrams, Availability and Irreversibility.

Module 3 **(08 hrs)**

Real & Ideal Gases: Deviation with ideal gas, Vander-wall's equation, evaluation of its constants, limitations of the equation. Generalized, compressibility chart, P-V-T surface of a Real gas, Thermodynamics relations T-ds Equations, Maxwell relations and their applications. Gibbs and Helmholtz functions.

Module 4 **(09 hrs)**

Pure Substance: Phase, Phase-transformations, formation of steam, properties of steam, PVT surface, HS,TS,PV,PH,TV diagram, processes of vapor measurement of dryness fraction, Use of steam table and Mollier chart with Numerical Problem.

Module 5 **(07 hrs)**

Air standard cycles: Carnot, Otto, Diesel, Dual cycles and there comparison with P-V And T-S Diagram, two stroke and four stroke engines, non reactive gas mixture, PVT relationship, mixture of ideal gases, properties of mixture of ideal gases, internal energy, Enthalpy and specific heat of gas mixtures, Enthalpy of gas- mixtures.

Course Outcomes:

After completion of this course, the students are able to:

1. Explain the concepts of thermodynamics and analyze the different applications of first law of thermodynamics.
2. Evaluate entropy change in wide range of processes and determine the reversibility or irreversibility of a process from such Calculation.
3. Understand the various thermodynamic Equation and their Significance
4. Evaluate various properties of a steam with the help of steam table and Mollier charts.

5. Compare the different types Air standard cycles and explain the behavior of Ideal and Real gases mixture.

List of Reference Book:

1. P. K. Nag; Engineering Thermodynamics;TMH
2. Van GJ; Thermodynamics; John Wylen
3. Cengel Y; Thermodynamics;TMH
4. Arora CP; Thermodynamics;TMH
5. Mahesh M Rathore; Thermodynamics;TMH
6. Thermal Engineering by R Yadav
7. Engineering Thermodynamics by Omkar Singh New Age International.

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HSMC-HS03	**Innovation & Creativity**	**1L;0T;0P**	**Credits: 01**

Pre requisite(s): Nil

Course Objectives:

1. To give an insight into creativity and innovation
2. To develop an appreciation for innovation among students, and
3. To enhance sensitivity to creativity and innovation

UNIT I: Overview of Creativity

Meaning and concept of creativity, Process, Nature and characteristics of creativity, Factors affecting creativity.

UNIT II: Overview of Innovation

Difference between Invention & Innovation, Importance & Principles of Innovation, Process of Innovation, Domain wise Innovations, How to safe guard innovations.

UNIT III: Tools for Innovation

Traditional V/s Creative Thinking, Individual Creativity Techniques: Meditation, Self-Awareness, & Creative Focus Group Creative Techniques: Brain Storming, off The Wall Thinking

UNIT IV: Evaluation of Effectiveness of Innovation- Legal Aspects like IPR, patent filing, copyright, Patenting Procedures, Design patents etc.

UNIT V: Innovation Management

Concept, Scope, Characteristics, Evolution of Innovation Management, Significance, Factors Influencing Innovation. Organizational Aspects- Economic Aspects like venture capital, angel investors.

Case Studies on Innovation business ideas i.e. RedBus, Flipcart, Ola, Big Basket, Patented products, Chemical products and Materials, special patents of procedures.

Course Outcomes: After completion of the course the student will be able to

1. Analyze creativity concepts and principles & process for problem solving.
2. Understand innovation & apply creativity for innovation.
3. Understand innovative products or services.
4. Apply design thinking tools techniques for IPR.
5. Understand the concept of Innovation Management.

Text Books:

1. S.Salivahanan, S.Suresh Kumar, D.Praveen Sam, “Introduction to Design Thinking”, Tata Mc Graw Hill, First Edition,2019.
2. Kathryn McElroy, “Prototyping for Designers: Developing the best Digital and Physical Products”, O’Reilly, 2017.

Reference Books:

1. Michael G. Luchs, Scott Swan, Abbie Griffin, “Design Thinking – New Product Essentials from PDMA”, Wiley, 2015.
2. Vijay Kumar, “101 Design Methods: A Structured Approach for Driving Innovation in Your Organization”, 2012.

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LC-ME01(P)	**Material Science Laboratories**	**0L;0T;2P**	**Credits: 01**

List of Experiment:

1. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test
2. Preparation of specimen for Metallographic examination and Metallographic study of given specimen through metallurgical microscope.
3. To study hardness as a function of quench rate and investigate the hardenability of steels by Jominy End Quench Apparatus.
4. To gain experience with and understanding of the types, advantages and applications of various NDT methods. To be able to choose the best NDT method for a given part and perform Test on UFD machine.
5. To determine carbon and sulphur contents in iron and steel by Strohlein's Apparatus.
6. Study of Annealing process of heat treatment and its effect on microstructure and Mechanical Properties.

Virtual Lab Experiment:

1. Material Response to Micro structural, Mechanical, Thermal and Biological Stimuli Lab
2. Micro structural analysis of Stainless Steel
3. Comparison between Mild Steel and Grey Cast Iron
4. Severity of Quenching

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LC-ME03(P)	**Strength of Material Laboratories**	**0L;0T;2P**	**Credits: 01**

List of Experiment:

1. To Study The Universal Testing Machine (U.T.M.)
2. To perform tensile test on Universal Testing Machine.
3. To determine Impact strength of steel by Izod test.
4. To determine Impact strength of steel by Charpy test.
5. To determine Hardness of Mild Steel (Rockwell Hardness Test).
6. To determine Hardness of Mild Steel (Brinell Hardness Test).
7. To determine Hardness of Mild Steel (Vicker's Hardness Test).
8. To determine Modulus of rigidity by torsion test of mild steel and aluminum rod.
9. To determine .Modulus of Elasticity of different materials of beam simply supported at ends.
10. To perform Shear test on Mild Steel.

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LC-ME04(P)	**Thermodynamics Laboratories**	**0L;0T;2P**	**Credits: 01**

List of Experiment:

1. Study of Boiler terminology and their Classification.
2. Study of working Low Pressure Boilers with demonstrate model.
3. Verify Joule's Experiments on Mechanical Equivalent of Heat.
4. Study of Temperature Measuring devices.
5. To Calculate the dryness fraction of Steam using Combined separating Throttling calorimeter
6. Determine the COP of Simple Vapour Compression Refrigeration System.
7. Find the calorific value of fuel by using Bomb Calorimeter.
8. Study of valve timing diagram for two and four stroke engines.

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SBC-ME02(P)	**Manufacturing Practice Laboratories**	**0L;0T;2P**	**Credits: 01**

List of Experiment:

1. Plain and Taper turning – one job
2. Wooden pattern - one job
3. Mold making (green sand mould) – one job
4. Welding (gas or arc) – one job
5. PCB Making -one job

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LLC-02	Liberal Learning Course -II	**0L;0T;2P**	**Credits: 01**

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MLC-01	Professional Laws, Ethics, Gender, Human Values and Harmony	**1L;0T;0P**	**Credits: Audit**

Course Outcomes :

Students will be able to

1. Understand the meaning of the concept - Law
2. Basic Knowledge of the laws relating to Engineers
3. Importance of being a law abiding person
4. Self Development by using different techniques to live in harmony at various levels
5. Understand their position with respect to the moral
6. Ethical character needed for a successful and satisfactory work life

Unit I: Concept of Law : Understanding Essentials of a Valid Contract and he basics of contract law protecting rights and obligations [02 Hrs]

Unit II: **Law and Ethics:** Professional Code of Conduct for Engineers Relationship between Law and Ethics. [01 Hrs]

Unit III: **Self Awareness** : Understanding oneself and others; Will be the Productive [02 Hrs]

Unit IV: **Needs & Self:** Needs and its importance; Understanding harmony and its relevance in actualization at personal and professional levels [02 Hrs]

Unit VI: **Ethics and Values:** Professional ethics and their importance for students; Understanding the importance of values & their application in everyday life [02 Hrs]

Reference Books :

- Business Law- By Saroj Kumar
- Law of Contract- By Avtar Singh
- Business Law- By G K Kapoor
- Business & Commercial Laws – By Sen & Mitra

- Business Law for Engineers- by Calvin Frank Allen
- Hilgard, E. R.; Atkinson, R. C. & Atkinson, R.L. (1975). Introduction to Psychology. 6th Edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
- Govindarajan, M; Natarajan, G. M. & Senthilkumar, V.S. (2013). Professional Ethics & Human Values. Prentice Hall: New Delhi
- Gogate, S. B. (2011). Human Values & Professional Ethics. Vikas Publishing: New Delhi.
- Govindarajan, M; Natarajan, G. M. & Senthilkumar, V.S. (2013). Professional Ethics & Human Values. Prentice Hall: New Delhi