

SEMESTER VIII

Program: B.Tech
Semester: Eight
Course: Operational Research in Mining
Course Code: 8PCCMiE405

L	T	P	C
3	0	0	3

Course Learning Objective:

- CLO 1:** The students will learn the concept of system engineering and applicability in mining field.
- CLO 2:** The students should have awareness about optimization and utilization of resources & apply operations research technique like Simplex, two phases, Big M in managerial operations.
- CLO 3:** The students should have facility with mathematical & computational modelling of real decision making problems, including the use of modelling tool and computational tools as well as analytic skill to evaluate the problems based on Assignment and Transportation.
- CLO 4:** To study the various techniques of operations research, simulation and network analysis.
- CLO 5:** Enables the students to know basic of system engineering concept and analysis.

Course Outcome:

On the completion of the Course, the students will be able to:

- CO 1:** Formulate real-world problems as a linear programming model and describe the theoretical workings of the graphical and simplex method.
- CO 2:** Formulate specialized linear programming problems, namely transportation and assignment problems and describe theoretical workings of the solution methods for transportation and assignment problems.
- CO 3:** To develop the abilities in project evaluation techniques like PERT, CPM etc.
- CO 4:** Apply the knowledge of game theory concepts to articulate real-world decision situations for identifying, analyzing, and practicing strategic decisions to counter the consequences.

Course Content:

Topics	Hours
Unit 1:	
Linear Programming :Linear Programming models; Assumption of linear programming, Graphical and Simple method of solving Linear Programming Problems; Basic and Basic feasible solution, optimal solution, interpretation of SIMPLEX table. Primal and Dual Problem. Application of Linear Programming for solution of mining related problems of production planning, scheduling and blending.	8
Unit II:	
Transportation and Assignment Problem: Transportation models, Solution. Algorithm for Transportation problem. Assignment model, Variations on Classical Assignment model; solution algorithm for Assignment problems. Mathematical formulation of an assignment problems. Difference between transportation and assignment problems.	8
Unit III:	
Project Management with PERT & CPM: Assumption of PERT and CPM; Methods of drawing network; Rules of network construction, numbering the events, construction of network, Time analysis ; Forward pass computation; backward pass computation; determination of floats and slack times; Critical path calculation.	8
Unit IV:	
Game Theory: Definition; pay off, types of games, the Maximin- Minimax principle, games without saddle point, graphical method, dominance property.	6

Suggested Reading:

1. *Numerical Methods in Engineering and Science* by Grewal B.S. and Grewal J.S
2. *Optimization: Linear Programming* by B K Mishra and B N Mishra
3. *Linear Programming: Foundations and Extensions* by Robert J Vanderbei

Program: B.Tech
Semester: Eight
Course: Mine Legislation and Safety II
Course Code: 8PCCMiE406

L	T	P	C
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Course Objective:

CLO 1: Enables the students to understand the organizational structure, working safety and management concepts for mining enterprises to effectively manage them within the frame work of rules and regulations.

CLO 2: Students will be acquainted with rules, laws and order for running a mine.

CLO 3: The students will have knowledge on various acts, rules and regulations relating to the mineral industry.

CLO 4: They will also know about accidents, diseases and mine safety.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Apply knowledge of legislation in mines for the implementation of rules and regulations during their job.

CO 2: Define work effectively with other engineering and science teams for suggesting any measures against any mine accidents.

CO 3: State application of various acts, rules and regulation

CO4: Interpret the cause and remedies of various accident disease and mine safety.

Course Content:

Topics	Hours
Unit 1:	
Mineral Conservation & Development Rule 2017 (Amended up-to-date): Applicability & Definitions, Reconnaissance & prospecting operations, Mining operations plans & sections, Sustainable mining, Notices & returns, Employment of mining engineers & geologists, Examination of Mineral & issue of directive , Revision & penalty, Miscellaneous & others. Mineral Concession Rules 1960 (Amended up-to-date): Important provisions regarding grant of lease, Acquisition of Land etc.	10
Unit II:	
Mines Rescue Rules 1985 (Amended up-to-date)- Important provisions. Indian Electricity Rules 1961 (Amended up-to-date): Definitions, Important provisions regarding additional precautions to be adopted in Mines & oilfields. Industrial Disputes Act 1947 (Amended up-to-date): Important provisions regarding strike, Lockent, Lay off, Retrenchment, Grievance Committee, Redressal Machinery, Work Board, court, Tribunals, Unfair Labour practices, Miscellaneous & other safety aspects of Mines.	8
Unit III:	
Mine Accident: Occupational hazards of mining; Accidents and their classification; Statistics of fatal and serious accidents; Frequency and severity rates of accidents; Place-wise and Cause-wise analysis, Henrich Triangle. Basic causes of accident occurrence; Investigations into accidents and accident reports; Measures for improving safety in mines; Cost of accidents.	6
Unit IV:	
Mine Safety: Introduction to safety management system and risk assessment. Analysis-safe condition- unsafe condition- mine safety- safety objectives- major factors to be considered for safety - safety week- pit safety committee- safety organization and safety policy.	6

Suggested Reading:

1. *Central Government, Mines Act 1952, Lovely Prakashan, Dhanbad*
2. *Central Government, Mines Rules 1955, Lovely Prakashan, Dhanbad*
3. *Central Government, Coal Mines Regulation 1957, Lovely Prakashan, Dhanbad*
4. *Central Government, DGMS Circulars, Lovely Prakashan, Dhanbad*
5. *Ghatak, A Study of Mine Management Legislation and General Safety, Shining Printers, Asansol*

Program: B.Tech
Semester: Eight
Course: Mine Management
Course Code: 8PCCMiE407

L	T	P	C
3	0	0	3

Course Learning Objective:

CLO 1: Students gain knowledge on the basic management principles to become management(s) professional.

CLO 2: Students will be acquainted with rules, laws and order for running a mine.

CLO 3: At the end of the course, the student should be able to the students would be able to understand the basic application of operational tools and manufacturing.

CLO 4: Develop leadership and a good communication skill.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Summarize the evolution theory of management and sketch the structure & design of organization.

CO 2: Acquire knowledge and hands-on competence in applying the concepts of management in the development of mine economics.

CO 3: Analyze and solve financial management problems.

CO 4: Illustrate leadership skills and be able to be knowledgeable in behavioral science.

Course Content:

Topics	Hours
Unit 1:	
Management- concept, Definition, Elements/ Factors of management, Taylor's Five elements of management, management vs administration; Evolution of management theory and practice; Scientific management, elements & principles of scientific management, MBO & its limitation.	8
Unit II:	
Personnel management: Recruitment, Selection, Training and Development of human resources for mining enterprises.	4
Unit III:	
Finance management: Capital budgeting techniques for mine projects; Methods of cost analysis and cost control, Break-even analysis. Material Management: Store, purchase, rate contract (RC), original equipment manufacturer, directorate general of supplies & disposal (DGS & D), ABC analysis, XYZ analysis V.E.D. Indicator, Economic order quantity, procedure for procurement, Limited Tender inquiry, open tender or advertised tender, DGSD rate contract, emergent purchase.	10
Unit IV:	
Behavioral sciences for management: Industrial Relations: Concepts and relevant regulations, Organization-perception & theory, modern organization theory (system & contingency approach), types, forms of organization, Business organization, company, holding company & subsidiary company Conflicts in organization; Motivation; Leadership; Communication. Structure and design of organization for mining enterprises.	8

Suggested Reading:

- 1. Mine Management Legislation (up to 2004)[Vol.I to VII] (Coal) by H P Soni*
- 2. Hand Book of Mine Management Legislation & General Safety by R K Raman*

Program: B.Tech
Semester: Eight
Course: Fuel Technology and Mineral Processing
Course Code: 8PCCMiE408

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Course Learning Objective:

CLO 1: The course enables the students to select the suitable parameters and appropriate machinery for processing various types of minerals.

CLO 2: Give the students an understanding of how the basic mineral processing unit operation can be combined into specific processes.

CLO 3: Students will be acquainted with mineral separation methods – an overview, including: physical separation (gravity, magnetic and electrical); solid/liquid separation; flotation.

CLO 4: To understand the leaching process & sampling processes.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Apply knowledge of mineral dressing for understanding, formulating and solving problems related with mineral dressing.

CO 2: Acquire knowledge and hands-on competence in applying the concepts in the design and development of machines for separating the low grade ore economically.

CO 3: Design & understand the various methods for mineral beneficiation.

CO 4: Demonstrate the knowledge on leaching and laboratory sampling process.

Course Content:

Topics	Hours
Unit 1:	
Fuel Technology & Solid fuels: Wood, peat, lignite, coal, anthracite; proximate and ultimate analysis; coal characteristics for different industrial uses; characteristics of Indian coals; caking and coking properties; low and high temperature carbonization. Liquid fuels: Petroleum its products and testing methods. Gaseous fuels: Natural gas, producer gas and water gas. Combustion: Combustion stoichiometry; Coal burning equipment.	8
Unit II:	
Mineral Processing & Introduction: Scope, objectives and limitations of mineral processing; Liberation and beneficiation characteristics of minerals and coal. Comminution: Theory and practice of crushing and grinding; Different types of crushing and grinding equipment, their application and limitations. Size separation: Laboratory size analysis and interpretation; Settling of solids in fluids; Industrial screens; Mechanical classifiers and hydrocyclones.	8
Unit III:	
Gravity concentration methods: Jigging, heavy media separation, flowing film concentrator's, theory, application and limitations. Froth flotation: Physico-chemical principles; Reagents; Machines; Flotation of sulphides, oxides and coal. Electrical and magnetic methods of concentration: Principles, fields of application and limitations.	8
Unit IV:	
Dewatering: Thickener and filter. Hydro-metallurgical methods of recovery: Leaching- principle, various methods and applications. Laboratory sampling, Simplified flow sheets for coal, copper, lead, zinc, gold, iron, manganese ores and lime stone.	6

Suggested Reading:

1. *Mineral Processing Technology* by B A Wills
2. *Introduction to Mineral Processing* by E G Kelly and D J Spottiswood
3. *Mineral Processing* by S K Jain

Program: B.Tech**Semester:** Eight**Course:** Fuel Technology and Mineral Processing Lab**Course Code:** 8PCCMiE405

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List of Experiments:

1. Proximity analysis of coal.
2. Concentration of sulphide ore by Froth Floatation Method.
3. Crushing by Jaw roll crusher.
4. Concentration of Magnetic ore by Magnetic separation method.
5. Coal Washery.

Program: B.Tech
Semester: Eight
Course: Mine and Mineral Economics
Course Code: 8PCCMiE409

L	T	P	C
3	0	0	3

Course Learning Objective:

CLO 1: The course enables the students to understand the economics of business enterprise to become a successful manager.

CLO 2: Students gain knowledge on the basic management principles to become management(s) professional.

CLO 3: Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

CLO 4: Expertise the students to brings employment, government revenues, and opportunities for economic growth and diversification through mining.

CLO 5: Study of estimation and valuation of mineral deposit and study of project appraisal.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Apply knowledge of mine economics for understanding mineral related policies and solve problems related with the mine economics.

CO 2: Analyze and solve the concepts of mine economics, its risk and mineral inventory.

CO 3: Describe the concept of mine sampling & illustrate the valuation of mineral deposit and be able to estimate the mine life and profitability.

CO 4: Discuss the forms of business, royalty, taxes & duties in mining sector.

Course Content:

Topics	Hours
Unit 1:	
Mineral Industry in India: Public and Private Entrepreneurship; Organization of mining enterprises, Mineral Resources' and reserves, Mineral resource estimation; UNFC and JORC Classification, Techno-economic feasibility studies.	8
Unit II:	
Cut-off grade, dilution and recovery, mineral conservation and development; Time value of money. Discounted cash flow concept, Net Present Value and Internal Rate of Return (IRR), Determining appropriate discount rate.	9
Unit III:	
Mine Valuation, Project financial indicators; Consumer Price Index, Effects and Inflation, Real and nominal interest rates; Cost accounting in Mining Operation, Cost -volume-Profit analysis, Depreciation and Amortization; Introduction to Mining finance, non-banking mine finance and stock operation; Quantification and management of mining investment risk.	8
Unit IV:	
Coal grade and Pricing, Average Sale price fixing for metalliferous ores, Mineral Lease Mineral auction, cost of mine closure; National Mineral Policy, Mineral trade and business; national and International Perspective. Critical Minerals.	7

Suggested Reading:

1. Gentry D.W., O'Neil T.J. (1984). *Mine Investment Analysis*. Society for Mining Metallurgy & Exploration, Englewood, CO (USA).
2. Ray S. C., Sinha I. N. (2016). *Mine and Mineral Economics*, PHI Learning.
3. Runge I. C. (1998). *Mining Economics and strategy*. Society for Mining Metallurgy & Exploration, Englewood, CO (USA).
4. Michael S. (2019). *Mining Capital*, Springer Nature, Switzerland AG.
5. Marian R., Wårell L. (2021). *A Handbook of Primary Commodities In The Global Economy*, Cambridge University Press.
6. Prasanna C. (2019). *Financial Management: Theory and Practice (10 Edition)*, McGraw Hill Education (India).

OPEN ELECTIVE (ANY ONE OF THE FOLLOWING SUBJECTS)

Program: B.Tech

Semester: Eight

Course: Engineering Economics

Course Code: 8OEEL401

L	T	P	C
3	0	0	3

Course Learning Objective:

CLO 1: Enable students to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.

CLO 2: Students will have knowledge of liability, insurance and safety/environmental requirements on projects.

CLO 3: Prepare engineering students to analyze cost/revenue data and carry out make economic analyses in the decision making process to justify or reject.

CLO 4: The objectives of this course are to review with students basic economic principles with students.

CLO 5: Educate the students on how to systematically evaluate the various cost elements of a typical manufactured product, an engineering project or service, with a view to determining the price offer.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Describe the concept of demand & supply and its managerial application.

CO 2: Estimate the Present, annual and future worth comparisons for cash flows.

CO 3: Calculate the capital investment, net present value & internal rate of return.

CO 4: Account & analyses the sustainability, income determination and fluctuations in economy.

Course Content:

Topics	Hours
Unit 1:	
Introduction, demand and supply, statistical demand and supply analysis, managerial application of the elasticity of demand and supply.	7
Unit II:	
Estimation of production and cost function; forecasting techniques and their use for decision making at different levels; linear programming and production analysis. Price output determination: a review with special reference to condition of uncertainty, kinds of pricing problems.	9
Unit III:	
Capital market and investment decisions: pay back method, average return on investment or accounting rate of return, net present value, and internal rate of return.	6
Unit IV:	
Outline of welfare economics, resource accounting and sustainability, income determination and fluctuations.	6

Suggested Reading:

1. *Engineering Economics* by Dr. R.K. Singal & Er. Rishi Singal
2. *Engineering Economics* by Panneerselvam

Program: B.Tech
Semester: Eight
Course: Industrial Management
Course Code: 8OEEL402

L	T	P	C
3	0	0	3

Course Learning Objective:

CLO 1: To make the students aware of the outline of managerial functions relating to manufacturing.

CLO 2: At the end of the course, the student should be able to understand the basic application of operational tools and manufacturing.

CLO 3: Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

CLO 4: Learn various aspect of reliability

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Apply management practices & & practice the various management theory.

CO 2: Describe the effectively the formation of companies, financial analysis and costing, & operation Research.

CO 3: Identify strategies for deployment and management of human resources on organization.

CO 4: Understand Project management & assurance Sciences.

Course Content:

Topics	Hours
Unit 1:	
Management functions, Evolution of management theory and practice, organization.	6
Unit II:	
Formation of companies, financial analysis and costing, engineering economy, work study. Elements of Operation Research- PERT, CPM, LPP, Scheduling and Sequencing.	8
Unit III:	
Deployment and management of human resources, Product engineering, Plant location and layout, production planning and inventory control.	6
Unit IV:	
Project management, Assurance Sciences – reliability, quality and maintainability.	6

Suggested Reading:

- 1. Industrial Management by O.N.Pandey*
- 2. Industrial Management by K. Patrai*
- 3. A Text Book of Industrial Management by A.P.Verma and N.Mohan*

Program: B.Tech
Semester: Eight
Course: Coal Bed Methane Mining
Course Code: 8OEEL403

L	T	P	C
3	0	0	3

Course Learning Objective:

CLO 1: After completion of this course student will be aware of alternate fossil fuels, their production methods.

CLO 2: Upon completion of this course, the students can able to identify the new methodologies / technologies for effective utilization of renewable energy sources

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Explain technology & process for coal bed methane exploration.

CO 2: Analyze the CBM reservoir & methane estimation.

CO 3: Understand the concept of hydraulic fracturing in coal bed.

CO 4: Interpret the method of compression & transportation in CBM.

Course Content:

Topics	Hours
Unit 1:	
Coalification process and coal grades. Methane generation and storage in coal; Geological control in Coal Bed Methane (CBM) exploration; Methane adsorption, desorption in coal.	8
Unit II:	
Coal as CBM reservoir: In-place methane estimation; Transport of methane in coal-bed. Drilling & Completion of a CBM hole/well. Identification and characterization of coal beds by hole/ well logs.	8
Unit III:	
Hydraulic fracturing in coal beds. Production performance of a CBM hole/well; Water drainage & gas-water separation. Gas volume measurement.	8
Unit IV:	
Compression & transport; Liquefaction and utilization. Enhanced recovery by CO ₂ and N ₂ adsorption methods.	6

Suggested Reading:

1. *Progressive Technologies of Coal, Coal bed Methane, and Ores Mining* by Volodymyr Bondarenko, Iryna Kovalevs'ka
2. *Advanced Reservoir and Production Engineering for Coal Bed Methane* by Pramod Thakur
3. *Fundamentals of Coal bed Methane Reservoir Engineering* by John Seidle

Program: B.Tech
Semester: Eight
Course: Project Management
Course Code: 8OEEL404

L	T	P	C
3	0	0	3

Course Learning Objective:

CLO 1: To make the students aware of the outline of managerial functions relating to manufacturing.

CLO 2: At the end of the course, the student should be able to understand the basic application of operational tools and manufacturing.

CLO 3: Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

CLO 4: Learn various aspect of reliability

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Apply management practices & & practice the various management theory.

CO 2: Describe the effectively the formation of companies, financial analysis and costing, & operation Research.

CO 3: Identify strategies for deployment and management of human resources on organization.

CO 4: Understand Project management & assurance Sciences.

Course Content:

Topics	Hours
Unit 1:	
Project: definition, characteristics, types, project life cycle, identification of projects. Project management: meaning and scope.	6
Unit II:	
Managing the Project: Project Planning and Implementation, Project Monitoring, Evaluation and Control, Project Cost Analysis, Managing Issues in Projects, Managing Risks.	8
Unit III:	
Project appraisal methods & Technical appraisal: meaning, need factors considered in technical appraisal. Market appraisal: market survey for forecasting future demand and sales; concepts, terms and techniques involved in it. Financial appraisal: estimated funds required, sources of funds, profitability analysis,	8
Unit IV:	
Investment Feasibility Studies : managing Project Resources Flow, Project Feasibility studies, Project Cost – Capital & Operating , Forecasting Income, Estimation of Investment & ROI, Project Evaluation, Financial Sources, Appraisal Process, Issues in Project Management : Project Audit, Project Monitoring & MIS, Cost Control, Real Time Planning	8

Suggested Reading:

- *Planning Analysis : Selection Implementation & Review, P Chandra : Tata McGraw Hill.*
- *Text Book of Project Management, P Gopalkrishnan& V E Ramamoorthy : McMillan*
- *Project Management & Control, N. Singh, Himalaya publishing house Project Management ,V Desai*

Program: B.Tech
Semester: Eight
Course: Mining project Work
Course Code: 8PROJMiE402

L	T	P	C
0	0	10	5

Course Learning Objective:

CLO 1: To provide the students an opportunity to express their skills, academic knowledge, practical experience and ability to analyze problems.

CLO 2: The aim of the project is to stimulate creative and innovative aspects of their technological learning.

CLO 3: The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Mining graduates would be equipped with managerial skill which would be useful to them for achieving their program educational outputs.

CO 2: Explain the mining practices needed for current Indian coal mining scenario for sustainable development to meet organizational objective.

CO 3: Contribute towards improvement in production and productivity including optimization of manpower in mines.

CO 4: Detailed understanding of the scientific principles associated with various coal beneficiation techniques.

CO 5: Develop skill for time bound projects implementation and production commissioning with appropriate technology adoption for economic mining & effective coal beneficiation.

Any project /research work related to mining area.

Program: B.Tech

Semester: Eight

Course: Human Values and Ethics

Course Code: 8HSMC402

L	T	P	C
2	0	0	0

Course Learning Objective:

CLO 1: To make students aware of the key aspects of Indian culture and ethics.

CLO 2: To become acutely aware of the crisis developed within Indian human values and ethics.

CLO 3: To have a clear concept of the need for inculcating values into individual life and taking it to the larger domain.

CLO 4: To sensitize the student's mind towards gender discrimination and the need to create an equal society.

CLO 5: To make the students actively participate in sustaining and maintaining a clean environment.

Course Outcome:

On completion of the Course, the students will be able to:

CO 1: Have a strong belief in our rich cultural and social heritage.

CO 2: Balancing their core values with dynamics of changing world.

CO 3: Thinking twice before supporting any kind of gender discriminatory act and sensitizing others towards building an equal society.

CO 4: Helping to build a strong family and retaining social values.

CO 5: Actively helping to save natural resources and cleaning the environment.

Course Content:

Topics	Hours
Unit 1: VALUE CRISIS IN CONTEMPORARY INDIAN SOCIETY	
1.1 Value Crisis at the Individual Level 1.2 Societal Level 1.3 Intellectual Level 1.4 Cultural Level 1.5 Value – What are they? 1.6 The Indian Concept of Values. 1.7 Modern Approach to the Study of Values. 1.8 Aesthetic Sensibilities	6
Unit II: MORAL AND ETHICAL HUMAN VALUES	
2.1 Bases for Moral Judgment 2.2 Some Canons of Ethics. 2.3 Virtue Ethics.	7

<p>2.4 Ethics of Duty. 2.5 Ethics of Responsibility 2.6 Factors to be considered in Making Ethical Judgments. 2.7 Different Meanings of Human Values 2.8 A New Approach to Human Value ,Freedom, Creativity Love &Wisdom</p>	
Unit III: MORAL VALUES IN PROFESSION	
<p>3.1 What is a Profession? 3.2 Professional Ethos 3.3 Code of Professional Ethics 3.4 Practicing the Code 3.5 Corporate Social Responsibility 3.6 The Larger Domain of Human Values 3.7 Institutionalizing Ethics and Human Values</p>	6
Unit IV: GENDER SENSITIZATION	
<p>4.1 Socialization of women 4.2 Just Relationships, being together as equals 4.3 Declining sex ratio, demographic consequences 4.4 Women’s work, its politics and economics, fact and fiction, unrecognized and Unaccounted work 4.5 Domestic violence, eve teasing and harassment. Is home a safe place?</p>	5

Suggested Reading:

1. *Dr. Rajan Mishra, Human Values: Laxmi Publications Pvt. Ltd.*
2. *S. Dinesh Babu, Professional Ethics and Human Values; Laxmi Publications Pvt. Ltd.*
3. *P.S. Rathore. Business Ethics And Communication; S.Chand Publishing*
4. *Dr. K.Alex. Managerial Skills; S. Chand Publishing.*
5. *Dr. M. Adithan, Study Skills For Professional Students For Higher Education , S.Chand Publishing*
6. *Govindarajan M “Professional Ethics and Human Values.”*
7. *R.R. Gaur and R. Sangal “ A Foundation Course in Human Values and Professional Ethics”*

Websites:

- www.tatamcgrawhill.com/digital Solutions/ monopoly
- www.schandedutech.com
- www.laxmipublications.com