VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 801 M Instrumentation and Control

	Lectures	Tutorial	Practical
Teaching Hours	3	1	0
Examination scheme Marks	100	25	Continuous Evaluation 00 Examination 00

1. Basic concept of control system, classification, transfer function, block diagram and signal flow graph.
2. Control system components, derivative, proportional and integral controllers and their combinations, Relative merits and drawbacks, hydraulic and pneumatic control systems, industrial applications of graph.
3. Response characteristic of control systems lap lace transformation, stability criteria, root locus and route stability criterion.
4. Method of least square Generalized performance characteristics of instruments first and second order instruments, response of a general form of instrument to step and linear input.
5. Data acquisition and processing, general data acquisition system, signal conditioning, data transmission- A-D and D-A converters, data storage and display devices.
6. Transducers, primary and secondary transducers, active and passive transducers-photo emissive cells-hall effect transducers.

Reference:

1. Peter dransfield, engineering systems and automatic control, printive hall of India pvt. Ltd., New Delhi.
2. J.P. Holman and W.J. Gajda, experimental methods for engineers, McGraw-Hill international book company, New Delhi 1989.
3. E.O. Doebalin, Measurement system-application and design, McGraw-Hill Book Company, New York, 1975.
4. Beckwith, T.G. and W.L. Buck, Mechanical Measurements, 2nd edition, Addison wesely publishing company, Inc., Reading, mass, 1969.
5. I.J. Nagrath and M. Gopal, Control systems engineering, Wiley Eastern ltd., New Delhi.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 802 M Elements of gas turbines

	Lectures	Tutorial	Practical
Teaching Hours	3	1	0
Examination scheme Marks	100	25	Continuous Evaluation 00 Examination 00

A.

1. Introduction: perfect gas, sonic velocity, mach number, regimes of flow, static and stagnation properties.
2. Isentropic flow: Governing equations, area-velocity relations, critical conditions, nozzles and diffusers, use of gas tables.
3. Fanno flow: Governing equations, fanno lines and its characteristics, chocking.
4. Rayleigh flow: Governing equations, Raleigh line and its characteristics, flow with maximum heat transfer.
5. Normal shocks: Governing equations, shock strength, Rankin hugonoit relation, pradtl-mayer equation, performance of a convergent –divergent nozzle.

B.

1. Gas turbine cycles: brayton cycle, methods of improving performance, open and closed cycles, co-generation.
2. Centrifugal composer: Governing equation, components and their function, types of impellers, slip factor, pre-whirl, non-dimensional parameters, performance, surging and stalling.
3. Axial flow compressor: basic operation, velocity triangles, factors affecting pressure rise chocking, degree of relation, calculation of blade parameters, polytrophic efficiency, losses, performance, surging and stalling.
4. Combustion chambers: Types, design requirements, arrangements of combustion chambers, losses, combustion efficiency, stability limits.
5. Application of gas turbine plants.

Reference:

1. Yahaya, S.M. Gas Dynamics, Tata Mc-Graw Hill, 1982.
2. Cohen, H., Roger GFC, Sravanamutto, H.I.H., Gas turbine theory, Longman, U.K., 1987.
3. Khajuria P.R., Dubey, S.P., Gas turbines and propubive systems, dhanpat rai & sons, Delhi, 1997.
4. Saad, M.A., compremible fluid flow, prentice hall, 1986.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 803 M Production Technologies II

	Lectures	Tutorial	Practical
Teaching Hours	3	0	2
Examination scheme Marks	100	00	Continuous Evaluation 20 Examination 30

Introduction to metrology, measurement of length and angle, gear and thread measurement, surface roughness measurement, optical instruments, limit-fit-tolerance and limit gauges.

Introduction to plastic deformation and yield criteria, mechanics of forming processes, cold and hot forming processes, analysis of forming, rolling, drawing, extrusion etc

Introduction to FMS, structure, objectives, elements type, section of configuration, design problems of FMS

Introduction to ‘artificial, intelligence, expert system development, concept, frame work, steps for development of expert system, expert system approach to FMS.

Design and selection of single and multipoint tools. Design of blanking and piercing dies.

- Laboratory experiments will be based on above syllabus.

Reference:

1. R.K.Jain, “Engineering Metrology”, khanna publishers, 1997.
2. Dr. R. Narayanswami, “Metal forming Technology”, Ahuja Book publishers, 1997.
3. A Gosh, A.K. Malice, “Manufacturing Science”, East-West press, 1988.
4. Dr. Surendrakumar, A.K. Jain, “CAD-CAM”, Dhanpat rai & sons, 1933.
5. “Fundamentals of Tool Design”, ASTME, prentice hall of India, 1983.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 804 M Industrial Management Techniques

	Lectures	Tutorial	Practical
Teaching Hours	3	1	0
Examination scheme Marks	100	25	Continuous Evaluation 00 Examination 00

1. Linear programming, formulation, graphical method, simplex method, difficulties in simplex method, duality.
2. Assignment & transportation models.
3. Sequencing problems, flow shop & job shop problems, methods of solution.
4. Project management with CPM, PERT.
5. Theory of games, two persons zero sum games, dominance rule, application of LP to game problems.
6. Statistical quality control, control charts for variables, proportional defectives. Control & specification limits, percentage defectives, relative precision index (RPI).
7. Acceptance sampling, operating characteristics curves, single, double, multiple and sequential sampling plans, AOQ, AOQL.
8. Patents and copyrights: patents laws GATT, TRIPS, IPR etc. in Global Perspective. Patents invention, modification, product and process patents copyright.

References:

1. S.D. Sharma, “operations research”, kedarnath ramnath & co., 1996.
2. N.D. Vohva, “Quantitative Techniques in Management”, Tata McGraw Hill. 1990.
3. N.R. Dave & A.K. Manglani, “operations research”, acharya publications, 1992.
4. R.C. Gupta, “Statistical Quality control”, khanna publishers, 1994.
5. Navayanen, “Patents”.
6. Dr. N.S. Gopalkrishnan, “Intellectual; properly”.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 805 M Seminar

	Lectures	Tutorial	Practical
Teaching Hours	00	0	2
Examination scheme Marks	00	00	Continuous Evaluation 20 Examination 30

This shall consist of a seminar report prepared by a student based on studies conducted on a technical topic by referring to literature and presentation of the same before the examiners and students as decided by the head of the department.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 805 M Project

	Lectures	Tutorial	Practical	
Teaching Hours	0	0	8	
Examination scheme Marks	00	00	Continuous Evaluation Examination	80 120

This shall consist of work carried out by a student during the period of final & pre final semesters with the main purpose of developing the ability of applying the knowledge gained in the undergraduate studies to some practical problem. The work may consist of one or many of the activities such as design analysis, fabrication, experimentation, product design and development, design and development of laboratory equipments/test rigs, developing computer programmes/software, industry based project etc.

Each student should submit a detailed project report at the ends of the final semester along with a certificate from Head of department for examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 820 M (Elective II) Maintenance Engineering

	Lecture	**Tutorial**	**Practical**
Teaching Hours	3	1	0
Examination Scheme Marks	100	25	Continuous Evaluations 00 Examination 00

1. Introduction to maintenance concepts, maintenance systems, maintenance management.
2. Introduction to condition monitoring.
3. Quantative techniques in maintenance resources.
4. Computers in maintenance, replacement strategies, pert, cpm, quening etc. Applicable to maintenance.
5. Maintenance documentation.
6. Heat treatment, Fits, tolerance and surface finish necessary for maintenance.
7. Maintenance of transmission system bearing ,housing, lead screw, guide ways, machine spindle, hucks, Hydraulic system, Presses cranes, hammers etc.
8. Restoration and manufacture of parts by welding, metallization, plating, etc. Manufacturing and Machine norms.

REFERENCES:

1. L.C.C. Morrow (Editor) Maintenance Engineering Handbook, McGraw Hill.
2. Anthony A Kelly, Maintenance, planning and control, Prentice Hall.
3. N.D.Vohra Quantative Techniques in management, Tata-McGraw Hill,1992.
4. H.P.Garg, Industrial maintenance, S.Chand and company Ltd. 1990

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 821 M (Elective II) Design of Machine Tools

	Lecture	**Tutorial**	**Practical**
Teaching Hours	3	1	0
Examination Scheme Marks	100	25	Continuous Evaluations 00 Examination 00

1. General principles of machine tool design, Tool force for Various machining Processes.
2. Kinematics of machine tool-selection of speeds & Feeds, Design of gear box, steples drives.
3. Design of machine tool structures-principle, Materials, static &dynamic Stiffness, & shapes of machine tool structures, Design of beds, columns, housings, tables, etc.
4. Design of guide ways & power screws-Design of slide ways.
5. Design of spindles-Materials of spindles – Machine tool compliance, -Antifriction bearings sliding bearings.
6. Dynamic of Machine tools Dynamic of characteristics of elements and systems- Dynamic of characterization of cutting processes –stability analysis, -forced vibrations of Machine tools.
7. Control systems in Machine tools –hydraulic & Pneumatics. Controls of Machine tools systems

REFERENCES:

1. N.K.Mehta, “Machine Tool Design” Tata-McGraw Hill, 1984.
2. S.K.Basu, D.K.Pal, “Design Machine Tools” Oxford & IBH Publishing co.1983.
3. Acherkan N. Machine Tool Design Vol. I-IV, Mir publishers, Moscow ,1968.
4. Koenigsberger, K. “Design Principles of metal cutting Machine tools”, pergaman press, 1964
5. G.C.Sen, A. Bhattacharya, “Principles of Machine Tools” New central book Agency, 1971.
6. Tobias ,S.A , “Machine Tool vibration”, Blackie Oxford,London.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 822 M (Elective II) Design of heat exchanger

	Lectures	Tutorial	Practical
Teaching Hours	3	1	0
Examination scheme Marks	100	25	Continuous Evaluation 00 Examination 00

1. Heat exchanger types, constructional details of different heat exchangers, selection of heat exchangers.
2. Design of double-pipe exchangers: Tube-side heat transfer and pressure loss calculations, annular heat transfer and pressure loss calculations.
3. Shell and tube heat exchangers: Approximate sizing of shell & tube heat exchangers, shell-side and tube side calculations. Design procedure for plain and finned tubes.
4. Design of compact heat exchangers and regenerators. Types of regenerator matrix. Design of coils.
5. Design of radiation furnaces, well stirred model and longitudinal model.
6. Fouling mechanisms, growth and its effect. Methods for minimizing fouling.
7. Flow induced vibrations.

Reference:

1. Kern D.O., Process Heat Transfer, Tata McGraw Hill. 1997.
2. E.A. Saunders, Heat Exchangers, Longmen Scientific & Technical Pub., 1998.
3. Heat Exchangers Design Handbook, Vol. 1 to 5, VDI, 1983.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 823 M (Elective II) Design of alternative energy systems

	Lectures	Tutorial	Practical
Teaching Hours	3	1	0
Examination scheme Marks	100	25	Continuous Evaluation 00 Examination 00

1. Design of wind machines, basic theory, design concept, design of Dutch type wind machine, designing three bladed propeller type wind machine, site selection.
2. Design of solar cooling system: absorption principles, aqua-ammonia, Li-Br-H2O system, determination of collection area for a given cooling application.
3. Design of biomass energy systems, alcohol fermentation, anaerobic digestion, design of biogas plant based on total cost minimization, factors influencing biogas plant performance.
4. Gasifier-engine based gen-sets. Decentralized electricity generation, biomass gaifier, its principle chemical reactions, design concepts of biomass gasifier, performance.
5. Solar photo-voltaic system, theory of solar cells, design concepts of PV system, concept of PV-diesel hybrid system.
6. Thermion generators & fuel cells: The electricity generation potential, principles and design of thermion generators & fuel cells.

Reference:

1. Peter Auer “Advance in Energy Technologies vol. 1 & 2” academic press, 1977.
2. Twidell J.W., Weir A.D., renewable energy resources, ELBS pub., 1986.
3. ASHRAE “Handbook of Fundamentals”, 1986
4. Chawla, O.P. “Advance in Biogas Technology, Indian Council of Agriculture Research, New Delhi, 1986.
5. Mani. A. and Mooley D.A., “Wind Energy Data for India”.
6. Sukhatme S.P., “solar energy principles of thermal a collection and storage”, 2nd Edi, Tata Mc-Graw hill, New Delhi, 1996.
7. Duffie, J.A. and Beckman, W.A. “Solar engineering of thermal processes” 2nd Edi, John Wiley & sons, N.Y., 1991.
8. Tiwari G.N., Juneja Saneeta. “Solar Thermal Engineering Systems”, Narosa publishing house, New Delhi, 1997.
9. Sayigh A.A.M. “Solar Energy Engineering” Academic press, N.Y., 1997.
10. Kreith F. and Kreider J.F. “Handbook Of Solar Energy” Mc Graw Hill, N.Y. 1980
11. Channiwala S.A. “Solar Energy Data Book”.
12. A. Mani and Mooley D.A. “Solar Radiation Data For India”.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 824 M (Elective II) Design of mechanical handling equipments

	Lectures	Tutorial	Practical
Teaching Hours	3	1	0
Examination scheme Marks	100	25	Continuous Evaluation 00 Examination 00

1. Introduction: material handling equipments, classification and their selection. Concept of material handling system design.
2. Lifting Equipments: classification and selection & design of steel wire ropes, chains, hooks, sheaves, drums and grab buckets. Classification of cranes, construction working of different types of conveyors, feeders and elevators.
3. conveying equipments: classification construction and working of different types of conveyors, feeders and elevators.
4. design of belt conveyors, screw conveyors and vibratory conveyors.

Reference:

1. J.M. Apple, “Plant Layout and Material Handling”, john Wiley & sons, 1997.
2. N. Rudenko, “material handling equipments”, MIR publishers.
3. M.P. Alexandrov, “material handling equipments”, MIR publishers.
4. Spivakovskii, “conveyors and related equipments”. MIR publishers.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 825 M (Elective II) Cryogenics

	Lecture	**Tutorial**	**Practical**
Teaching Hours	3	1	0
Examination Scheme Marks	100	25	Continuous Evaluations 00 Examination 00

1. Historical Background & application
2. Gas Liquifaction systems, Ideal Liquifaction systems, Linde, Claude, Heylanjt, and Kapitza and their thermodynamics analysis.
3. Gas separation and Purification systems, Ideal separation of Gases, Principle of Gas separation, Air separation systems.
4. Cryogenic refrigeration systems, Ideal cryogenic refrigeration systems, joule-thomsan, Linde hampsion refrigeration cycles, closed cycle cryo refrigerators.
5. Storage and handling of cryogens.
6. Cryogenic Insulation and their types.
7. Measurement of strain, pressure, flow, Temperature and liquid level in cryogenic range production and measurement of vaccum.
8. Heat exchangers, compressors, Expanders for cryogenic systems.
9. Laboratory Demonstration

REFERENCES:

1. Hastlden C, “Cryogenic Fundamentals’’ Academic press, 1970.
2. Barron R. “Cryogenic systems’’ plenum press, 1960.
3. Walker, “Cryocoolers Vol I &II’’ plenum press, 1980.
4. Mikulin Y, “Theory and design of Cryogenic systems’’, MIR Publication, 1985.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 826 M (Elective II) Robotics

	Lecture	**Tutorial**	**Practical**
Teaching Hours	3	1	0
Examination Scheme Marks	100	25	Continuous Evaluations 00 Examination 00

1. Introduction to Robotics, Robot types of configuration and Anatomy, Drives systems, Trajectory planning & Motion ,Basic of Robot arm kinematics and dynamics.
2. End effectors –types , constructional details and working.
3. Sensors Robot Programming Language.
4. Robot Intelligence and task planning.
5. Application , Introduction to Robot Vision systems.

REFERENCES:

1. K.S.Fu, R.C. Gonzalez, C.S.G. Lee Robotics , McGraw-Hill International edition ,1987.
2. Groover, Weiss, Nagal and odery Industrial Robotics, McGraw-Hill International edition, 1988.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 827 M (Elective II) Design of Management of Small Enterprises

	Lecture	**Tutorial**	**Practical**
Teaching Hours	3	1	0
Examination Scheme Marks	100	25	Continuous Evaluations 00 Examination 00

1. Introduction: Objective of Entrepreneurship –scope, risks and rewards, -characteristics of an Entrepreneur.
2. Economic and Industrial Requirements : current economic and industrial environment – Linkage among small, medium and large industrial sectors, Entrepreneurial Ventures and economic growth –business opportunity identification –ancillaries, subcontracting, demand based resources based and service based, industrial –Import substitution.
3. Setting Up An Industry: Forms of business organization –formation of a company procedures and formalities for setting up of new industry –sources of information incentives, subsidies and concessions industrial development agencies and their functions – state level and national level Institutions for small industry promotion.
4. Marketing: Component of marketing –market survey and analysis- Marketing arrangement strategies and assistance to small industry promotion.
5. Product Development: Creative thinking and organizing for product lunovation –functional Design and cost optimization factors affecting product design –stage of product design,- process analysis –selection of plant and Machinery –Reliability &Quality control patents.
6. Project Planning : Techno-economic feasibility studies and economic analysis payback periods average of return net present value –internal rate return and cost benefit analysis – break even analysis –assessment of fixed capital and working capital requirements financial viability –sources of finance –Financial Ratio analysis.
7. Project Finance: Detailed assessment of fixed capital and working capital factors affecting working capital-operating cycle –methods of calculating working capital –sources of finance for working capital.
8. Project Report : Preparation of detailed project report –project implementation programme evaluation and Review technique –Critical path Method.

REFERENCES:

1. Vasant Desai, “Dynamics of entrepreneurial development and management’’ Himalaya Publishing House Mumbai, 1996
2. Prasanna Chandra “Projects” ,Tata McGraw –Hill Publishing company Limited , New Delhi- 1995.
3. Vasant Desai Volume –II, “Entrepreneurship Development” Himalaya Publishing House Mumbai, 1991
4. James L. Riggs, “Production systems”, John willey & Sons ,New-York,1987.
5. Benjamin W. Niebel, “Product design and process engineering” McGraw –Hill Kogakusha Ltd. Tokyo.
6. Desai, A.N. “Environment and Entrepreneur”, Ashish Publishing House, New-Delhi, 1989.
7. J.M.Pandey “Financial Management” Vikash publishing House Pvt .Ltd. New-Delhi, 1997.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 828 M (Elective II) Design of pressure vessels - piping

	Lectures	Tutorial	Practical
Teaching Hours	3	1	0
Examination scheme Marks	100	25	Continuous Evaluation 00 Examination 00

Factors influencing the design of vessels-classification of pressure vessels, material selection, loads & types of failures

Stresses in pressure vessels stresses in circular ring, cylinder & sphere, membrane stresses in vessels under internal pressure, thick cylinders, multilayered cylinders, stress consideration in the selection of flat plat & conical closures, elliptical, semispherical, hemispherical heads, autoretage of thick cylinders, thermal stresses & their significance, fatigue of pressure vessels.

Design of pressure vessels as per ASME & is codes, externally pressurized vessels, tall vertical vessels, support for vertical & horizontal vessels, nozzles & flanges. Discontinuity stresses in pressure vessels.

Basic concepts, flow through pipes, fanno & Reynolds flow, pressure drop in isothermal & non-isothermal flows.

Head losses, loss due to contraction & expansion, loss due to fittings, equip mental length, distribution & mixing losses.

Reference:

1. M.V. Joshi & V.V. Mahmani, Process Equipment Design, Macmillan, India, Ltd., 1996.
2. J.F. Hanvey, pressure vessels design, von nostrand co. Inc.
3. ASME code section 8^{th} div. 1, div. 2.
4. K.P. Singh & A.L. Solen, Mechanical Design of Heat Exchangers, Arcrunus pub. Inc. N.J. 08003, USA, 1984.
5. Demis R. Moss, Pressure vessel design manual, gulf publishing co., Houston, 1987.
6. IS 2825.
7. Hand Book of piping Design.
8. ASHRAE fundamentals 1985

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 829 M (Elective II) Total quality management

	Lectures	Tutorial	Practical
Teaching Hours	3	1	0
Examination scheme Marks	100	25	Continuous Evaluation 00 Examination 00

1. Quality concepts & functions-various definitions such as quality function, quality measurement, quality costs. Quality in production, design marketing etc. Quality audit, SQC, quality assurance, total quality control.
2. TQM-Introduction, history, principles, quality policy, quality system, quality management, TQM system & models. Essentials of TQM.
3. Organizing for TQM-organizing for quality implementation, TQM organization structure, employee involvement, quality circles.
4. Costs of quality-benefits of costs of quality control, measurement of quality costs, use of quality cost information.
5. Tools and techniques for TQM-Taguchi and PQKa-Yoke technique, Kaizen, PDCA cycle, flow diagram, 5s campaign, 7QC cause & effect diagram, FMEA & FTA etc.
6. ISO 9000 quality management system-ISO 9000 elements, application and benefits. Zero defect implementation registration & certification for ISO 9000.
7. Just-In-Time & TQM-JIT production, system, KANBAN, JIT techniques such as waste deduction, total production maintenance (TPM), push versuns pull systems.
8. Case studies on TQM.

Reference:

1. N. Logo thesis, “Managing for total quality”-prentice hall of India pvt. Ltd. – 1997.
2. Joel E. Ross, “Total Quality Management”-variety book international, New Delhi-1995.
3. K.C. Jain & A.K. Chitale-Quality Assurance & TQM-Khanna publishers, New Delhi-1998.
4. S.M. SundavaRaju- “Total Quality Management”- Tata Mc Graw Hill Publishing Co.P. Ltd., New Delhi-1995.
5. A.N. Singh-“prevention, implementation & registration of ISO 9000 Quality System”-Dolphin Books, New Delhi-1993.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.E- IV

Mechanical

Semester -VIII

MED 830 M Fluid Power Engineering

	Lecture	**Tutorial**	**Practical**
Teaching Hours	3	1	0
Examination Scheme Marks	100	25	Continuous Evaluations 00 Examination 00

1. Introduction: Fluid power types, Systems, and their applications Desirable properties of hydraulic & Pneumatics .Selection of fluid, components of FPS.
2. Hydraulic Symbols: Circuit elements, fluid pumps and motors, Hydraulic valves, Types of controls, Reservoirs for fluids, miscellaneous units, composite symbols.
3. Fluid power Pumps: Classification, reciprocating, rotory, centrifugal, working principle, performance characteristics curves, selection .Design Considerations.
4. Fluid Reservoirs: Types function, setting Tank etc.
5. Pressure Accumulators: Types, selection & Design considerations.
6. Filters and strainers: Filter types circuits rating pressure drops in filters operation and maintenance.
7. Fluid Temperature control : Types of heat exchangers used for oil cooling .Design consideration for fluid temperature.
8. Control Valves : Pressure control valves, flow-control valves Directional Control valves.
9. Fluid Seals: Types, Materials for seals, seal lubrication.
10 Electrical Devices for hydraulic circuits: Solenoids, Torque motors, Safety consideration.
11. Fluid power Actuators: Linear actuators, gear motors, vane motors, piston motors, Hydraulic motor Performance.
12. Industrial hydraulic and pneumatic circuits.

REFERENCES:

1. Andrew Parr: Hydraulic and pneumatic, Jaico publishing House, 1994.
2. Peter Rohner: Industrial hydraulic Control Prentice Hall, 1987.
3. Pipepenger J.J.: Industrial hydraulics, Mc-Graw Hill Co. 1979.
4. Turn bull, B.L ; Fluid Power Engineering,Butterworth,1976.