M.D. UNIVERSITY, ROHTAK
(NAAC Accredited 'A+' Grade)

SCHEME OF STUDIES AND EXAMINATION
B.TECH (Mechanical & Automation Engineering)

3rd, 4th, 5th, 6th, 7th, 8th semester
Scheme effective from session 2022-23

COURSE CODE AND DEFINITIONS:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical

General Notes:

1. **Mandatory courses are non credit courses in which students will be required passing marks in internal assessments.**
2. **Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.**
3. **Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.**

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
Scheme of Examination for Semester III (Second Year)
B Tech (Mechanical & Automation Engg.)
w.e.f. Session 2022-2023

Sr. No.	Category Course Notation	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assesment	Theory	Practical	Total	
1	Basic Science course	BSC-MA-201G	Numerical Analysis & Programming	3	1	0	4	4	25	75		100	3
2	Engineering Science course	ESC-MA-203G	Electronics	3	1	0	4	4	25	75		100	3
3.	Professional Core courses	PCC-MA-205G	Thermal Science	3	1	0	4	4	25	75		100	3
4.	Professional Core courses	PCC-MA-207G	Mechanics of Solids	3	1	0	4	4	25	75		100	3
5.	Professional Core courses	PCC-MA-209G	Production Technology	3	1	0	4	4	25	75		100	3
6.	Professional Core courses	PCC-MA-211G	Mechanics of Fluids	3	1	0	4	4	25	75		100	3
7.	Engineering Science course	LC-MA-251G	Electronics Lab.	0	2	0	1	1	25		25	50	3
8.	Professional Core courses	LC-MA-253G	Mech. of Solids Lab	0	2	0	1	1	25		25	50	3
9	Basic Science course	LC-MA-255G	Programming-I (Numerical Analysis)	0	2	0	1	1	25		25	50	3
TOTAL CREDIT								**27**				**750**	

Course code	**BSC-MA--201G**				
Category	Basic Science course				
Course title	**Numerical Analysis & Programming**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**1**	**0**	**4**	
Objectives:	To develop numerical ability and to impart knowledge in Statistical methods and Probability theory and their applications in Engineering to enable them to apply that for solving real world problems.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Numerical Techniques: The solution of linear and non-linear equations: Direct Iteration method, Regula-Falsi method, Newton – Raphson method. Solution of system of simultaneous equations by Gauss elimination, Gauss-Jacobi and Gauss-Seidal methods.

Finite differences: Forward, backward and Central differences.

UNIT II:

Interpolation and Numerical Calculus: Newton's interpolation for equi-spaced values. Divided differences and interpolation formula in terms of divided differences. Stirling's central difference interpolation formula, Lagrange's interpolation formula for unequi-spaced values. Numerical Differentiation. Numerical Integration: Newton-Cote's quadrature formula, Trapezoidal rule, Simpson's one-third rule and Simpson's three-eighth rule.

UNIT III:

Numerical solution of ordinary differential equations: Picard's method, Euler's method, modified Euler's method, Runge-Kutta method of fourth order, Milne's predictor-corrector method.

UNIT IV:

Computer Programming: Writing programmes in C++ for solving numerical problems. For example, Programme for solving algebraic and transcendental equations by Newton-Rapson Method, solving simultaneous equations by Gauss-Seidal method. Programme for Interpolation by Lagrange's method. Programme for estimating the value an integral by Simpson's rule. Programme for solving differential equation by Runge-Kutta method, etc.

Course Outcomes : Students would be able :

1. To understand about the application of different numerical techanics
2. To understand about the basics of C++ for solving numerical problems
3. Students get familiar with differential equation.
4. To Understand about the computer programming.

Text Books:

1. V.P. Mishra; "Text Book of Engineering Mathematics", Galgotia Publications, Delhi.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, Delhi.
3. V.P. Jaggi and A.B. Mathur, "Advanced Engineer Mathematics", Khanna Publications, Delhi.

Reference Books:

1. S.S. Sastry, "Introductory Methods of Numerical Analysis", Prentice Hall of India Pvt. Ltd., New Delhi.
2. M.K. Jain, S.R.K Iyengar, R.K. Jain, "Numerical Methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi.

Course code	**ESC-MA--203G**				
Category	Basic Science course				
Course title	Electronics				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**1**	**0**	**4**	
Objectives:	Introduce basic topologies of power switching circuits , Introduce hardware and software used in power electronic switching circuits and power conditioning systems. Investigate integration of power electronic converters with electric machines. Power electronics modeling, simulation and experimental verification. Power electronics studies the application of semiconductor devices to the conversion and control of electrical energy.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Semiconductor Diodes: Introduction to Junction Diode, Rectifiers (Half wave & Full wave), Filters, Voltage Regulation and Voltage Multiplier. Types of Diodes (Zener, Photo, LED), Liquid Crystal Display (LCD), Introduction to Silicon Controlled Rectifier (SCR), DIAC, TRIAC.

Bipolar Junction Transistor: BJT Characteristics, CB, CE & CC Configuration, Load Line (DC & AC), Leakage Current, Saturation, Active & Cut off mode of operation of Transistor, Biasing methods.

UNIT – II

Small Signal Amplifier: CB, CE, CC, Amplifier, Hybrid Model Analysis of Common Emitter Amplifier, RC Coupled Amplifier, Mid-Band Model, gain and Impedance, Comparison of Different Configurations, Darlington Amplifier.

Large Signal Amplifier: Introduction to Class A, Class B, Class C Amplifier, Class B Push Pull Amplifier.

Oscillator: Concept of Negative & Positive feedback, Introduction to LC Oscillators

UNIT - III

Field Effect Transistor: Introduction, Classification, FET Characteristics, Depletion & Enhancement MOSFET.

Operational Amplifier: Op-Amp Model, Concept of Ideal Op-Amp, Concept of Virtual Ground, Inverting & Non-Inverting Amplifier, Differential Amplifier, Adder & Sub tractor, V – I & I – V Converter, Integrator, Differentiator, Comparators.

UNIT - IV

Digital Circuits: Binary operation, Boolean Algebra, Different Types of Codes (BCD, Gray, Excess-3, ASCII) DeMorgan's Law, Karnaugh Map, Different Types of Gates, Half Adder, Full Adder, Encoders, Decoders, Multiplexers, DeMultiplexers, Flipflops, Counters, Shift Registers, Introduction to RAMs and ROMs.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor devices and their applications.
2. Design an application using Operational amplifier.
3. Understand the working of timing circuits and oscillators.
4. Understand logic gates, flip flop as a building block of digital systems.
5. Learn the basics of Electronic communication system.

Text Books:

1. Millman & Halkias, "Electronic Devices & Circuits", Tata Mcgraw Hill
2. R.L. Boylestos & L. Nashesky, "Electronic Devices & Circuits", Pearson Education
3. S. Salivahenan, N. Suresh Kr. & A. Vollavaraj, "Electronic Devices & Circuit", Tata McGraw Hill.

Reference Books:

1. R.P. Jain, "Modern Digital Electronics", Tata Mcgraw Hill
2. Malvino & Leach, "Digital Principle And Applications", Tata Mcgraw Hil

Course code	**PCC-MA--205G**				
Category	Professional Core Courses				
Course title	Thermal science				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to introduce basic concepts, thermodynamics and other concepts related to thermal science.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

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UNIT - I

Basic concepts: Introduction to the Basic definitions of Engineering Thermodynamics. Thermodynamic systems : Closed, open and isolated systems. Microscopic and Macroscopic view. Intensive and Extensive properties. Zeroth law of Thermodynamics. Phase, State, Process, Cycle. Point functions and Path functions. Equation of state. Work and Heat.

First Law of Thermodynamics: Internal energy - a property arising from the First Law of Thermodynamics . Reversible Non flow processes p-*v* diagrams. Concept of Flow work, Enthalpy. Analysis of unsteady flow and steady flow processes and their applications. Throttling process.

UNIT - II

Second Law of Thermodynamics: Limitations of First law and necessity of Second Law of Thermodynamics. Claussius and Kelvin Planck statements. Reversible and Irreversible processes. Carnot cycle, Reversed Carnot cycle. Clausius inequality. Entropy - a property arising from the Second law of Thermodynamics. Expressions for change in entropy during various processes and representations on t-s diagrams.

Availability and Irreversibility : High grade and low grade energy. Available and unavailable energy. Dead state. Loss of available energy due to Heat transfer through a Finite temperature difference.

Availability. Reversible work and Irreversibility. Availability in non flow systems and steady flow systems. Second law efficiency.

UNIT - III

Thermodynamic Property Relations: Helmholtz and Gibbs function. Mathematical conditions for Exact differentials (Properties). Maxwell Relations. Clapeyron Equation.

Properties of a Pure Substance: Phase equilibrium of a Pure substance on t-*v* diagram. Normal boiling point of a Pure substance. Saturation states. Compressed liquid. p-v & p-t diagram of a pure substance. Saturated steam, Dry and saturated steam, Superheated steam. Use of Steam tables and Mollier diagram. Different processes of vapour on p-v and t-s diagrams. Measurement of Dryness fraction. **[**

UNIT - IV:

Gas Power Cycles: Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericsson cycle and Brayton cycle.

Vapour Power Cycles : Carnot cycle. Simple Rankine cycle. Effect of various parameters on the efficiency of Rankine cycle. Reheat and Regenerative cycles.

Course Outcomes:

1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions

2. Students can evaluate changes in thermodynamic properties of substances

3. The students will be able to evaluate the performance of energy conversion devices

4. The students will be able to differentiate between high grade and low grade energies

Text Books:

1. P.K. Nag, “Engineering Thermodynamics”, Tata McGraw Hill

Reference Books:

1. Sonntag/Vanhylene, “Fundamentals of Thermodynamics”, Wiley

2. Rahul Gupta, “Engineering Thermodynamics”, Asian Books P. Ltd.

3. Gordon Rosers, “Yon Mahew; Engineering Termodynamics”, Addison Wesley

4. Y.V.C. Rao, “Engineering Thermodynamics”, Khanna Publications.

5. E. Gutra, “Basic Thermodynamics”, Narosa Publications.

6. M.L. Mathur, “Mehta F.S. Thermal Engineering”, Jain Brothers

7. R.K. Rajput, “Thermal Engineering”, Laxmi Publications

8. Onkar Singh, “Applied Thermodynamics”, New Age Publications.

9. Dhomkundwar Kothandaraman, “A Course in Thermal Engineering”, Dhanpat Rai Publications

10. S.K. Kulshretha, “Engineering Thermodynamics”, Vikas Publications.

Course code	**PCC-MA--207G**				
Category	Professional Core Courses				
Course title	Mechanics of solid				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**1**	**0**	**4**	
Objectives:	The students in this course are required to analyse reasons for failure of different components and select the required materials for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. Hence this subject has been introduced. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles to the solution of applied problems to develop the required competencies.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Simple Stresses & strains: Tensile, Compressive, shear and volumetric stresses and Strains, stress strain diagram, complementary shear stress, lateral strain and Poisson's ratio.

Compound bars and Temperature stresses: Stresses in compound bars carrying axial loads and subjected to temperature stresses.

Complex stresses and strains: Principle stress and strain due to combination of stresses, Mohr's circle theories of Failures.

UNIT - II

Simple bending: Shear force and bending moment diagrams of cantilevers, beams under concentrated, uniformly varying loads with and without overhangs.

Stresses in beams and cantilevers under bending, beam of uniform strength, flitched beams, bending due to eccentric loads.

Slope and defection of cantilevers and beams under concentrated and uniformly distributed loads.

UNIT - III

Columns: Combined direct and bending stresses in columns, Euler's and Rankine Gordon equations.

Torsion: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts. Power transmitted by shafts; combined bending and torsion.

UNIT - IV

Springs: Close-coiled, open coiled springs under torque and moment.

Cylinders: Thin and thick cylinders, Lame's Theorem, compound cylinders, spherical vessels.

Course Outcomes:

1. After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

2. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Text Books:

1. Jindal U.C., "Strength of Materials", Galgotia Publication, New Delhi, 1998.
2. Ryder G.H., "Strength of Materials", Macmillan, Delhi, 2003.
3. R.K. Bansal, "Strength of Materials", Laxmi Publication, New Delhi, 2001.

Reference Books:

1. Sadhu Singh, "Strength of Materials", Khanna Publishers, New Delhi, 2000.
2. Timoshenko S.P., "Elements of Strength of Materials", East-West affiliated, New Delhi, 2000.
3. Hibbler R.C., "Mechanics of Materials", Prentice Hall, New Delhi, 1994.
4. Popov Eger P., "Engg. Mechanics of solids", Prentice Hall, New Delhi, 1998.
5. Fenner, Roger.T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi, 1990.
6. Sri Nath L.S. et.al., "Strength of Materials", McMillan, New Delhi,2001

Course code	**PCC-MA--209G**				
Category	Professional Core Courses				
Course title	**Production Technology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to facilitate the student with conventional techniques being used in industry for production purposes.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

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UNIT - I

Moulding: Cores, Core Prints, Core boxes, Pattern design, Pattern layout and construction, testing of moulding sand. moulding and core making machines, use of chaplets, CO_2 - Process, fluid sand process, shell moulding, cold curing process, hot-box method, high pressure and flask less moulding, Design of metal moulds, Die Design for die Casting.

UNIT - II

Casting: Directional principles, Solidification, types of gating systems, Pouring time and temperature. Design criteria of pouring basin, screw, runner, gate and riser, gating ratio, chill and its uses. Selection of melting furnaces, Crucible furnaces, Electric furnaces, Induction furnace, Control of melt and Cupola charge calculations. Foundry mechanization and lay out. Casting defects, Causes and remedies.

UNIT - III

Welding: Principle, classification, advantages, limitations and applications, Tungsten Inert Gas welding, Metal Inert Gas welding, Electro - slag welding, Electro - Gas Welding, Explosive Welding, Ultrasonic Welding, Electron Bean Welding, Laser Beam Welding, Friction Welding, Cold Welding, Thermit Welding, Codification of Electrodes, Welding Defects-causes and remedies.

UNIT - IV

Metal Forming: Introduction to Metal Forming, Hot Forming and Cold Forming, Description of Forging, Wire Drawing, Tube Drawing, Deep Drawing, Rolling Bending, Extrusion Blanking, Piercing.

Powder Metallurgy: Definition, advantages, limitations and applications, Powder metallurgy processes and operations, metal powders, their characteristics and manufacture.

Course Outcome (COs): At the end of the course, the student shall be able to:

1. .Demonstrate the knowledge about different sand moulding and metal casting processes.
2. Understand the plastic deformation of metals under rolling, extrusion, forging and sheet metal working.
3. Acquire knowledge about basic welding processes and their selection for fabrication of different components. CO 4 - Learn about different gear manufacturing and gear finishing operations.
4. Acquire the basics of powder metallurgy.

Text Books:

1. Rao P.N., "Manufacturing Technology",Vol.1, Tata McGraw Hill, 2003.
2. Sharma P.C., "A Text Book of Production Engineering", Vol.1, S. Chand Publication, New Delhi, 2001.

Reference Books:

1. Jain P.L., "Principles of Foundry Technology", Tata McGraw Hill, New Delhi, 1998.
2. Ramana Rao T.V., "Metal Casting Principles & Practices", New Age INT, New Delhi, 2003.
3. Heine & Rosenthal, "Principle of Metal Casting", Tata McGraw Hills, New Delhi, 2003.
4. Little Richard L, "Welding & Welding Technology", Tata McGraw Hill, New Delhi, 2003.
5. Raghuwanshi B.S., "Workshop Technology ",Vol.1, Dhanpat Rai Publication, N.Delhi, 2003.
6. Hazra Chaudhari, "Elements of Workshop Technology", Media Promoter Publication, New Delhi, 1998.
7. Jain, R.K., "Production Technology", Khanna Publishers, 2001.
8. HMT Bangalore, "Production Technology", Tata McGraw Hill, 1980.

Course code	**PCC-MA--211G**				
Category	Professional Core Courses				
Course title	**Mechanics of fluid**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-III**
	3	**1**	**0**	**4**	
Objectives:	The objective of this subject to provide an understanding of the fundamentals of fluid mechanics, an appreciation of the design principles in fluid systems, the ability to analyses existing fluid systems and contribute to new designs.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Fluid Properties and Fluid Statics: Newtonian and Non-Newtonian Fluids; Kinematic and dynamic Viscosity; Incompressible and compressible fluids, compressibility.

Forces on plane surfaces, forces on curved surfaces, buoyant forces, stability of floating bodies, metacentre and metacentric height.

Kinematics of Fluid Motion: Steady and unsteady flow; uniform and non-uniform flow; Laminar and turbulent flow; streamline, path line and streak line; continuity equation, irrotational and rotational flow, velocity potential and stream function, vortex flow, vortex lines, vortex tubes, free and forced vortex.

UNIT - II

Dynamics of Fluid Flow: Eulers equation of motion and its integration to yield Bernoulli's equation, graPrentice Hall Indiacal representation of Bernoulli's equation and its practical applications – Pitot tube, Venturi meter; steady flow momentum equation, force exerted by jet on plane surface and force exerted on a pipe bend.

UNIT - III

Dimensional Analysis and Principles of Similarity: Buckingham □ Theorem and its applications, Geometric, Kinematics and Dynamic similarity; Dimensionless numbers-Reynolds, Froude, Euler, Mach, Weber Number and their significance.

Boundary Layer Flow: Laminar and turbulent boundary Layer and laminar sublayer.

Boundary Layer thickness, displacement, momentum and energy thickness.

Laminar Flow : Reynold's experiment, critical velocity, steady laminar flow through a circular tube, flow between parallel plates, measurement of viscosity.

UNIT - IV

Turbulent Flow: Shear stress in turbulent flow. Hydrodynamically smooth & rough boundaries. Velocity distribution for turbulent flow in smooth and rough pipes.

Analysis of Pipe Flow: Energy losses, minor losses in pipe lines, concept of equivalent length, flow between two reservoirs, multiple pipe systems – in series and parallel, siphon.

Flow Measurements: Measurement of flow using Venturi meter, orifice meter, Pitot tube, Flow nozzle, Measurement of flow in open channels – rectangular, triangular, trapezoidal weir, Cipoeletti weir.

Course Outcomes: At the end of the course, the student shall be able to:

1. Expedite the properties of fluid along with pressure measurement techniques and concept of stability. 2. Understand the characteristics of fluid and application of continuity and Bernoulli's equation.

3. Conceptualisation of boundary layer, laminar and turbulent flow.

4. Analyse flows through pipes and open channels.

Text Books:

1. R.K. Basal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publications(P) Ltd.,2002.

2. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S.K. Kataria & Sons,2000.

Reference Books:

1. I.H. Shames, "Mechanics of Fluids", Tata McGraw Hill

2. V.L. Streeter and E.B. Wylie, "Fluid Mechanics", Tata McGraw Hill

Practicals:

Course Code	LC-MA--251G				
Category	Engineering Science course				
Course title	Electronics lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of experiments:-

1. To get familiar with the working knowledge of the following instruments:

    a) Cathode ray oscilloscope (CRO)
    b) Multimeter (Analog and Digital)
    c) Function generator
    d) Power supply

2. a) To measure phase difference between two waveforms using CRO

    b) To measure an unknown frequency from Lissajous figures using CRO

3. a) Plot the forward and reverse V-I characteristics of P-N junction diode

    b) Calculation of cut-involtage c) Study of Zener diode in breakdown region

4. To plot and study the input and output characteristics of BJT in common-emitter configuration

5. To find frequency response of a given amplifier and calculate its bandwidth

6. To get familiar with pin-configuration of typical op-amp(741) and its use as:

    a) Inverting amplifier

    b) Non-inverting amplifiler

    c) Summing amplifier

    d) Difference amplifier

7. Use of op-amp as

    a) Integrator

    b) Differentiator

8. To assemble Wein Bridge oscillator circuit and calculation of oscillation-frequency and its verification from the observed output .

9. Verification of truth tables of logic gates (OR,AND, NOT, NAND, NOR).

10. Verification of truth tables of flip-flops (S-R, J-K).

Course Outcomes: The students who have undergone the course will be able to understand working of CRO , BJT, Amplifier and accessories and understand the basic electronics devices and circuits .

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

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Course Code	LC-MA--253G				
Category	Professional Core Courses				
Course title	Mechanics of solid lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of experiments:-

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.

2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.

3. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.

4.To study the Impact testing machine and perform the Impact tests (Izod & Charpy).

5. To study the Universal testing machine and perform the tensile test.

6. To perform compression & bending tests on UTM.

7.To perform the sheer test on UTM.

8.To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and Distributed Loads.

9.To determine Mechanical Advantage and Efficiency of Single and Double Purchase Winch Crab.

10.To determine Mechanical Advantage and Efficiency of Worm and Worm Gear .

Course Outcomes: The students who have undergone the course will be able to understand working of UTM ,Rockwell , Brinell hardness tester, Mechanical advantage of gears .

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	LC-MA--255G				
Category	Engineering Science course				
Course title	Numarical Analysis lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

LIST OF EXPERIMENTS:-

1. Solution of algebraic and transcendental equation.

2. Algebra of matrices: Addition, multiplication, transpose etc.

3. Inverse of a system of linear equations using Gauss-Jordan method.

4. Numerical Integration.

5. Solution of ordinary differential equations using Runge-Kutta Method.

6. Solution of Initial value problem.

7. Calculation of eigen values and eigen vectors of a matrix.

8. Plotting of Unit step function and square wave function.

9. Study of introduction to MATLAB.

10. Program for solving numerical integration by simpson's 1/3 rule.

Course Outcomes: The students who have undergone the course will be able to understand working of MATLAB, properties of Matrix & basic numerical methods for problem solving.

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
BACHELOR OF TECHNOLOGY
(Mechanical & Automation Engg)
FOURTH (4th) SEMESTER EXAMINATION
w.e.f. Session 2022-2023

Sr. No.	Category Course Notation	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assesment	Theory	Practical	Total	
1	Professional Core courses	**PCC-MA-202G**	Kinematics of Machines	3	1	0	4	4	25	75		100	3
2	Professional Core courses	**PCC-MA-204G**	Heat Transfer	3	1	0	4	4	25	75		100	3
3.	Professional Core courses	**PCC-MA-206G**	Manufacturing Machines	3	1	0	4	4	25	75		100	3
4.	Professional Core courses	**PCC-MA-208G**	Electrical Machines	3	1	0	4	4	25	75		100	3
5.	Professional Core courses	**PCC-MA-210G**	Operation Research	3	1	0	4	4	25	75		100	3
6.	Professional Core courses	**PCC-MA-212G**	Mechanical Automation	3	1	0	4	4	25	75		100	3
7.	Professional Core courses	**LC-MA-252G**	KOM Lab.	0	2	0	1	1	25		25	50	3
8	Professional Core courses	**LC-MA-254G**	Electrical Machines lab.	0	2	0	1	1	25		25	50	3
9	Basic Science course	**LC-MA-258G**	Heat transfer lab	0	2	0	1	1	25		25	50	3
10	Mandatory course	***MC-106G**	Environment science	3	0	1							
TOTAL CREDIT								**27**				**750**	

Course code	**PCC-MA--202G**				
Category	Professional Core Courses				
Course title	**Kinematics of Machines**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**1**	**0**	**4**	
Objectives:	The objective of the subject is to expose the students to learn the fundamentals of various laws governing rigid bodies and its motions.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

. UNIT-I

Introduction: mechanism and machines, kinematics links, kinematics pairs, kinematics chains, degree of freedom, Grubler's rule, kinematics inversion, equivalent linkages, four link planar mechanisms, straight line mechanisms, steering mechanisms, pantograph, problems.

Kinematics Analysis of Plane Mechanisms: displacement analysis, velocity diagram, velocity determination, relative velocity method, instantaneous center of velocity, Kennedy's theorem, graphical and analytical methods of velocity and acceleration analysis, problems.

UNIT-II

Cams: Classification of cams and followers, disc cam nomenclature, construction of displacement, velocity and acceleration diagrams for different types of follower motions, analysis of follower motions, determination of basic dimension, synthesis of cam profile by graphical methods, cams with specified contours, problems.

Gears: fundamental law of gearing, involute spur gears, characteristics of involute and cycloidal action, Interference and undercutting, center distance variation, path of contact, arc of contact, non standard gear teeth, helical, spiral bevel and worm gears, problems.

UNIT-III

Gear Trains: synthesis of simple, compound and reverted gear trains, analysis of epicylic gear trains, problems.

Kinematics synthesis of Mechanisms: function generation, path generation, Freudenstein's equation, two and three position synthesis of four bar and slider crank mechanisms by graphical and analytical methods, precision positions, structural error; Chebychev spacing, transmission angle, problems.

UNIT-IV

Friction : Types of friction, laws of friction, motion along inclined plane, screw threads, efficiency on inclined plane, friction in journal bearing, friction circle and friction axis, pivots and collar friction, uniform pressure and uniform wear.

Belts and pulleys: Open and cross belt drive, velocity ratio, slip, material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts, ratio of tension, centrifugal tension, power transmitted by belts and ropes, initial tension, creep, chain drives, chain length, classification of chains.

Course Outcomes : Students would be able :

1. To understand about the applications of mechanism and machines.
2. To understand about the basics Cams and Friction
3. Students get familiarity about power transmitted with Belts and pulleys and also Gears and Gear Trains.
4. Students having familiarization with calculate Kinematics Analysis of Plane Mechanisms
5. Students would be able to know the Kinematics synthesis of Mechanisms.

TEXT BOOKS:

1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok kumar Malik, Third Edition Affiliated East-West Press.

2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, MGH, New York.

References:

1. Mechanism and Machine Theory : J.S. Rao and R.V. Dukkipati Second Edition New age International.

2. Theory and Machines: S.S. Rattan, Tata McGraw Hill.

3. Theory of Machines, Beven, Pearson Indian Education Service Pvt. Ltd. India.

Course code	**PCC-MA--204G**				
Category	Professional Core Courses				
Course title	Heat Transfer				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**1**	**0**	**4**	
Objectives:	The objective of this paper is to introduce the students about the knowledge of conduction, thermal radiation.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Conduction: One dimensional steady state conduction. Simple convection. Overall heat transfer coefficient. Simple cases of Heat Transfer through, homogenous and composite plane walls, cylinders and spheres with constant and variable thermal conductivity. Critical thickness of insulation. Heat transfer from Fins of uniform cross section.

UNIT – II

Convection: Concept of Hydrodynamic and Thermal boundary layers. Application of Dimensional analysis to Free and Forced convection. Important Dimensions- less numbers.

Heat transfer during Change of Phase: Film condensation and Drop wise condensation. Flow regimes. Heat transfer coefficient for Film Condensation. Boiling: Classification. Boiling regimes. Heat transfer correlations in boiling.

UNIT – III

Heat exchangers: Types of Heat exchangers. LMTD and NTU methods exchangers Design. Simple calculations.

Radiation: Kirchoffs law. Planck's distribution law. Wein's displacement law. Stenfan-Boltzmann's relation. Configuration factor. Radiant heat interchange between black and grey surfaces. Solar Radiation, Radiation shielding.

UNIT – IV

Gas Turbines: Gas Power Cycles–Thermal refinements. Performance of Gas turbines, Combined cycle. Principles of Jet Propulsion. Turbojet and Turbo-prop engines, Rocket engines.

Steam Turbines: Classification. Impulse and Reaction Turbines. Compounding of steam turbines. Velocity diagrams. Conditions for maximum efficiency. Governing of steam turbines. Losses in steam turbines. Reheat Factor.

Course Outcome (COs): At the end of the course, the student shall be able to:

1. Understand the basic concept of conduction, convection and radiation heat transfer.
2. Formulation of one dimension conduction problems.
3. Application of empirical correlations for both forced and free convection for determines the value of convection heat transfer coefficient.
4. Expedite basic concept of the radiation heat transfer for black and grey body.
5. Learning of thermal analysis and sizing of Heat exchangers.

Text Books:

1. R. Yadav, “Steam Turbines”, Asia Publications.
2. D.S. Kumar; “Heat & Mass Transfers”, S.K. Kataria & Sons.
3. M.L. Mathur, F.S. Mehta, “Thermal Engineering”, Jain Publication
4. R.K. Rajput, “Thermal Engineering”, Laxmi Publication

Reference Books:

1. J.P. Holman; “Heat Transfers” McGraw Hill, USA
2. Mills; “Heat Transfers”, C.B.S Publications.
3. Kearton; “Steam Turbine”, C.B.S Publications
4. Arora DomkundwaR, “A Course in heat & Mass Transfer”, Dhanpat Rai & Co.
5. Onkar Singh, “Applied thermodynamics”, New Age Publications
6. Dhomkundwar, “A course in Thermal Engg.”, Dhanpat Rai Publications
7. P.L. Ballaney, “Thermal Engg.” Dhanpat Rai Publications
8. Cohen Rojers, “Gas Turbine Theory”, Pearson’s Education.

Course code	**PCC-MA--206G**				
Category	Professional Core Courses				
Course title	Manufacturing Machine				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to facilitate the student with manufacturing processes using machine tools in use today and it's application in different type of Industries.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Introduction: Classification of machine tools based on application and production rate: General purpose, Single purpose and Special purpose machines, Classification based on-types of machine tools and the processes, Generating and forming.

Elements of metal cutting processes: Elements of tool geometry, cutting tool materials and applications.

Lathe: Various types of lathe: Centre lathe, facing lathe, gap-bed lathe, capstan and turret lathe, CNC lathe, major difference between CNC lathe and conventional lathe. Major sub-assemblies of a lathe: Bed, headstock, tail stock, carriage consisting of saddle, cross-slide, compound slide, tool post and apron. Work holding devices: self centering three jaw chuck, independent four jaw chuck, collets, face plates, dog carriers, centers and mandrels.

UNIT - II

Lathe contd... Driving mechanisms, apron mechanism, thread cutting mechanism and calculations, features of half-nut engagement – disengagement, indexing dial mechanism. Operations on lathe: taper turning, related calculations, thread cutting, facing, under-cutting, drilling, boring, parting-off, knurling, chamfering.

Reciprocating Type Machine Tools: Shaper, Planer and Slotter: Constructional features, basic machines and kinematics and related calculations .

UNIT III:

Drilling Machines: Constructional features of bench drilling machine, radial drilling machine, multi-spindle drilling machine, feed mechanism, work holding devices, Tool – holding devices. Different drilling operations: Drilling, reaming, counter boring and countersinking etc., estimation of drilling time.

Milling Machines: Types of general purpose milling machines: horizontal, vertical and universal. Types of milling cutters and their applications, different milling operations, work-holding devices: vice, clamps, chucks, dividing head and its use, simple, compound and differential indexing. Indexing calculations and machining time calculations. Introduction to machining centers .

UNIT IV:

Grinding Machines: Different types of grinding machines: cylindrical, surface and centre-less grinding machines, basic constructional features and mechanisms, specifications, different grinding operations, honing, lapping and super-finishing processes.

Gear Manufacturing Machines: Gear forming, gear generation, gear shaping and gear hobbing

Course Outcomes : Students would be able :

1. To understand about the working & applications of late and drilling machine .
2. To understand about the milling operations.
3. Students get familiar with Shaper, Planer and Slotter

Text Books:

1. P.N. Rao, "Manufacturing Technology: Metal Cutting & Machine Tools", Tata McGraw Hill, Delhi, 2004.
2. B.S. Raghuwanshi, "Workshop Technology", Vol.2, Dhanpat Rai & Sons, 2003.
3. Hazra Chandhari S.K., "Elements of Workshop Technology", Vol.2, Media Promoters, 2003.

Reference Books:

1. P.C. Sharma, "A Text Book of Production. Engineering", S. Chand, New Delhi, 2004.
2. Bawa H.S., "Workshop Technology", Vol.2, Tata McGraw Hill, 2004.
3. Juneja & Shekhon, "Fundamental of Metal Cutting", New Age Publications
4. S.F. Krar Stevan F. and Check A.F., "Technology of M/C Tools", McGraw Hill Book Co., 1986.
5. Kibbe Richard et al, "M/c Tool practices", Prentice Hall India, 2003.
6. Bangalore HMT, "Production Technology", Tata McGraw Hill, 1980.
7. R.K. Jain, "Production Technology", Khanna Publishers.

Course code	**PCC-MA--208G**				
Category	Professional Core Courses				
Course title	Electrical Machine				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**1**	**0**	**4**	
Objectives:	Providing sound knowledge about the principles of operation of various electrical machines, their constructional features, and their behavior and characteristics under various condition of operation.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT – I

D.C. Machines: D.C. Machines, constructional features, Principles of operation, DC generator analysis, DC motor analysis, Motor-speed-torque characteristic, speed control, applications of DC motors, starters and controllers of DC motors.

UNIT – II

A.C. Machines: Three phase induction motors, revolving magnetic field theory, induction motor as a transformers, equivalent circuit, computation of performance, starting, auto start, speed control.

UNIT – III

The Three Phase Synchronous Machine: Synchronous generator / motor phasor diagrams, equivalent circuits, computation of synchronous machine performance, synchronous condense.

UNIT – IV

Single phase induction motors, double revolving field theory, different types of single – phase induction motors, characteristics and typical applications. Fractional KW motors, stepper motors, hysteresis motor, Servo motors AC series motor and Universal motors.

Course Outcomes : Students would be able :

1. To understand about the working & applications of DC & AC machine.
2. To understand about the Three phase synchronous machine.
3. Students get familiar with induction motors.

Text Books:

1. Hughes Edward, “Electrical Technology”, Addison Wesley Longma Ltd.
2. Nagrath IJ and Kothari, “DP. Electrical M/C”, Tata McGraw Hill.

Reference Books:

1. Kosow L.L., “Electrical Machines & Transforms”, Prentice Hall India.
2. Fitzerald Kingsley, “Kusko, Dumas”, Electrical Machines, Tata McGraw Hill.
3. M.G. Say, “AC Machines”, Pitman & Sons.
4. P.S. Bimbhna, “Electrical Machinery”, Khanna Publication.

Course code	**PCC-MA--210G**				
Category	Professional Core Courses				
Course title	Operation Research				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to acquaint the student with mathematical techniques being adopted in industry which help managers in decision taking.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Linear Programming: Formulation of LP Problem. GraPrentice Hall Indiacal and Simplex method for maximization and minimization LP Problems. Duality in Simplex Problems, Sensitivity Analysis.

UNIT - II

Transportation Models: Stepping stone method & MODI method for optimality check, North West Corner Method, Least-cost Method and Vogel's Approximation Method (VAM) for solving balanced and unbalanced transportation problems. Problems of degeneracy and maximization.

Assignment Models: Assignment model for maximization & minimization problems. Traveling Salesman Problems, Industrial Problems.

UNIT - III

Queuing Theory: Basic structure, Terminology, Classification, Birth and Death Process. Queuing Models upto 2 service stations.

Sequencing Theory: Processing of n-jobs through m-machines with each job having same processing order. Processing of two jobs through m-machines with each job having different processing order.

UNIT - IV

Network Models: Introduction to PERT and CPM. Fundamental concept of Network models and construction of network diagrams. Activity time estimates. Critical path and project time duration. Probability of completing the project on or before specified time. Concept of Float and slack.

Games Theory: Two person zero-sum games. Minimax and Maximin principle. Arithmetic, Algebraic, Matrix Algebra method. Solution by Dominance, Subgame, GraPrentice Hall Indiacal and Linear programming method.

Course Outcomes (COs): At the end of the course, the student shall be able to:

1. Discuss the role of operations research in decision-making, and its applications in industry and should be able to formulate and design real-world problems through models & experiments.
2. Knowledge of various types of deterministic models like linear programming, transportation model etc.
3. Explore various types of stochastic models like waiting line model, project line model, simulation etc.
4. Deduce the relationship between a linear program and its dual and perform sensitivity analysis.
5. Describe different decision making environments and apply decision making process in the real world situations

Text Books:

1. N.D. Vohra, "Operations Research", Tata McGraw Hill, 2004.
2. J.K. Sharma, "Operation Research", Macmillan India Ltd. 2005.
3. H.A. Taha, "Operations Research", Prentice-Hall India, 6th Edition, 2004.

Reference Books:

1. Richard Bronson, Govindasami Naadimuthu, "Operations Research", Tata McGraw Hill, 2004
2. A.P. Verma, "Quantitative Techniques", Asian Books Pvt. Ltd., 2004
3. A.P. Verma, "Operations Research", S.K. Kataria & Sons, 2004.

Course code	**PCC-MA--212G**				
Category	Professional Core Courses				
Course title	Mechanical Automation				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-IV**
	3	**1**	**0**	**4**	
Objectives:	This course covers the basic principles of Mechanical Automation and automated manufacturing system				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

SECTION A

Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity. Material handling systems: Overview of Material Handling Systems- Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

SECTION B

Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines & Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly. Control Technologies in Automation: Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Sensors, Actuators and other Control System Components.

SECTION C

Evaluation of automatic production: product manufacturability, orientation devices- active and passive devices, parts orientation and Rocapement. Pneumatic and hydraulic components and circuits: Boolean algebra, pneumatic sensors and amplifiers, jet destruction devices, logic devices, schimit triggering devices, developing pneumatic circuits for automatic die casting machine.

SECTION D

Modeling and Simulation for manufacturing Plant Automation: Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

Course Outcomes (COs): At the end of the course, the student shall be able to get practical exposure of Automation Industry has been propelling economies internationally by enabling manufacturing and infrastructure to meet the growing needs across the globe. This cross disciplinary segment is the key to enhanced productivity, reliability and quality in multiple domains.

Reference Books:

1. Handbook of design, manufacturing & Automation : R.C. Dorf, John Wiley and Sons.

2. Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, Pearson Education.

3. Industrial Automation : W.P. David, John Wiley and Sons.

4. Computer Based Industrial Control, Krishna Kant, EEE-PHI

5. An Introduction to Automated Process Planning Systems, Tiess Chiu Chang & Richard A. Wysk

6. Manufacturing assembly Handbook:- BrunoLotter

7. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall. 8. Performance Modeling of Automated Manufacturing Systems, Viswanandham, PHI

Course Code	LC-MA--252G				
Category	Professional Core Courses				
Course title	Kinematics of Machine lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

LIST OF EXPERIMENTS:-

1. To study various types of Kinematic links, pairs, chains and Mechanisms.
2. To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. To find coefficient of friction between belt and pulley.
5. To study various type of cam and follower arrangements.
6. To plot follower displacement vs cam rotation for various Cam Follower systems.
7. To generate spur gear involute tooth profile using simulated gear shaping process.
8. To study various types of gears – Helical, cross helical worm, bevel gear.
9. To study various types of gear trains – simple, compound, reverted, epicyclic and differential.
10. To find co-efficient of friction between belt and pulley.
11. To study the working of Screw Jack and determine its efficiency.
12. Create various types of linkage mechanism in CAD and simulate for motion outputs and study the relevant effects.
13. Creation of various joints like revolute, planes, spherical, cam follower and study the degree of freedom and motion patterns available.
14. To design a cam profile by using the requirement graph using on-line engineering handbook and verify the same using a 3D mechanism on CAD.

Course Outcomes: The students who have undergone the course will be able to understand working of MATLAB, properties of Matrix & basic numerical methods for problem solving.

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	LC-MA-254G				
Category	Professional Core Courses				
Course title	Electrical Machines lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

LIST OF EXPERIMENTS:-

1. To study the magnetization characteristics of a separately excited D.C generator for different speeds

2 .To study the speed control of a d.c. shunt motor using A. Field current control method B. Armature control method

3 .To plot torque-speed characteristics and armature current characteristics of a D.C shunt motor.

4 .To determine the external or load characteristics of a D.C. shunt generator by actually loading the machine.

5 To study 3-point/ 4-point starter for D.C. shunt motor.

6 A. To perform no load and short circuit test on a three-phase synchronous generator.

B. Measure the resistance of the stator windings

C. Find the voltage regulation at full load at

(i) Unity power factor

(ii) 0.85 power factor leading

(iii) 0.85 power factor lagging by synchronous impendence method.

7 .To study the effect of variation of field current upon the stator current and power factor of a synchronous motor running at no load and half load, hence draw V and inverted V curves of the motor. 8 To Perform no load and blocked rotor test on three-phase induction motor and draw its equivalent circuit.

9 To perform load test on 3-phase induction motor and compute torque, output power, efficiency, input power factor and slip for various load settings. Plot the relevant graphs.

10 Perform no load and blocked rotor test on single-phase induction motor.

Course Outcomes: The students who have undergone the course will be able to understand working of DC motor, induction motor ,single and multiphase motor.

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	PCC-MA-258G				
Category	Professional Core Courses				
Course title	Heat transfer lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

LIST OF EXPERIMENTS:

1. To determine the thermal conductivity of a metallic rod.
2. To determine the thermal conductivity of an insulating power.
3. Measurement of heat transfer rate in a channel flow using winglets.
4. To determine the thermal conductivity of a solid by the guarded hot plate method.
5. To find the effectiveness of a pin fin in a rectangular duct natural convective condition and plot temperature distribution along its length.
6. To find the effectiveness of a pin fin in a rectangular duct under forced convective and plot temperature distribution along its length.
7. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlation.
8. To determine average heat transfer coefficient for a externally heated horizontal pipe under forced convection & plot Reynolds and Nusselt numbers along the length of pipe. Also compare the results with those of the correlations. 9. To measure the emmisivity of the gray body (plate) at different temperature and plot the variation of emmisivity with surface temperature.
10. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counter flow conditions. Also plot the temperature distribution in both the cases along the length of heat of heat exchanger. 11. To verify the Stefen-Boltzmann constant for thermal radiation.
12. To demonstrate the super thermal conducting heat pipe and compare its working with that of the best conductor i.e. copper pipe. Also plot temperature variation along the length with time or three pipes.
13. To study the two phases heat transfer unit.
14. To determine the water side overall heat transfer coefficient on a cross-flow heat exchanger.
15. Design of Heat exchanger using CAD and verification using thermal analysis package eg. IDeas etc.

Course Outcomes: The students who have undergone the course will be able to understand working of Heat Exchanger, fins , black body Radiation etc.

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
BACHELOR OF TECHNOLOGY
(Mechanical & Automation Engineering)
FIFTH (5th) SEMESTER EXAMINATION
w.e.f. Session 2023-24

Sr. No.	Category Course Notation	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assesment	Theory	Practical	Total	
1	Professional Core courses	**PCC-MA-301G**	Microprocessors & Applications	3	1	0	4	4	25	75		100	3
2	Professional Core courses	**PCC-MA-303G**	Machine Design- I	3	1	0	4	4	25	75		100	3
3.	Professional Core courses	**PCC-MA-305G**	Material Science & Metallurgy	3	1	0	4	4	25	75		100	3
4.	Professional Core courses	**PCC-MA-307G**	Automatic Control system.	3	1	0	4	4	25	75		100	3
5.	Professional Core courses	**PCC-MA-309G**	Hydraulic and Pneumatic	3	1	0	4	4	25	75		100	3
6.	Professional Core courses	**LC-MA-351G**	Microprocessors & Applications Lab	0	2	0	2	1	25		25	50	3
7.	Professional Core courses	**LC-MA-353G**	Machine Design- I Lab	0	4	0	4	2	25		25	50	3
8.	Professional Core courses	**LC-MA-355G**	Control System Lab	0	2	0	2	1	25		25	50	3
9.	Professional Core courses	**LC-MA-357G**	Programming - III Lab. (MATLAB)	0	2	0	2	1	25		25	50	3
10.	Professional Core courses	**LC-MA--359G**	Hydraulic and Pneumatic Lab	0	2	0	2	1	25		25	50	3
TOTAL CREDIT								**26**				**750**	

Course code	**PCC-MA--301G**				
Category	Professional Core Courses				
Course title	**Microprocessor & Applications**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	3	**1**	**0**	**4**	
Objectives:	To introduce the architecture and programming of 8085 microprocessor				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

. **UNIT – I**

Introduction To Microprocessors And Microcontrollers:

Introduction to Microprocessors and Microcontrollers, Number Systems and Binary arithmetic, MicroprocessorArchitecture (8085 and 8086) and Microcomputer Systems, Memory Map and addressing,memory classification, review of logic device for interfacing, Memory Interfacing, Overview of 8085 Instruction Set, stacks and Interrupts.

UNIT - II

The 8051 Architecture:8051 Microcontroller hardware, oscillator and clock, Prog. Counter and Data Pointer, Registers and Program Status word, Internal Memory RAM, Stack and Stack Pointer, Special Function Registers, Internal ROM. Input / Output Pins, Ports and Circuits, External Memory, Counters and Timers, Serial Data Input and Output, Interrupts.

UNIT - III

Assembly Language & Programming The 8051: Assembly Language programming, Programming the 8051, Moving Data, Logical Operations, Arithmetic Operations, Branching Operations, Interrupts.

UNIT - IV

Microcontroller 8051 design: Microcontroller specification and Design, External Memory and Memory space decoding, Memory – mapped I/O, Memory Access times, Timing Subroutines, Lookup Tables for 8051, Serial Data Transmission.

Interfacing Peripheral Devices To 8051 And Applications: Interfacing A/D Converters and D/A Converters, 8255, 8259. Application to interfacing Scanned Displays, Matrix Keyboard, Memory Design, Data Acquisition System Design.

COURSE OUTCOME.

1. Understanding the principles of operations and characteristics of **Microprocessors And Microcontrollers.**
2. Knowledge of **Assembly Language & Programming.**
3. Know about the different types of **Microcontrollers.**

Text Books:

1. K.J. Ayala, "The 8051 Microcontroller, Architecture, Programming & Applications", Thomsom Delmer Learning.
2. RS Gaonkar, "Microprocessors Architecture, Programming and Applications", Penram International.

Reference Books:

1. M.A. Mazidi. & J.G Mazidi, "The 8051 Microcontroller & Embedded Systems", Pearson Education.
2. B.Ram, "Fundamentals of Microprocessors and Microcomputers", Dhanpat Rai and Sons.

Course code	**PCC-MA--303G**				
Category	Professional Core Courses				
Course title	**Machine Design-I**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	3	**1**	**0**	**4**	
Objectives:	The primary objective of this course is to demonstrate how engineering design uses the many principles learned in previous engineering science courses and to show how these principles are practically applied. The emphasis in this course is on machine design: the design and creation of devices that consist of interrelated components used to modify force and/or motion.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT – I

Introduction: Principles of mechanical design, systematic design process, aesthetic and ergonomic considerations in design, use of standards in design.Manufacturing consideration in design, casting, machining, forging.Dynamic and fluctuating stresses, fatigue failure and endurance limit, stress concentration, causes and remedies in design,Factor of safety, Tolerances and types of fits, Selection of materials

UNIT – II

Design of Elements: Cotter and knuckle joints; screwed fastenings, bolted and riveted joints under direct and eccentric loads, initial tightening loads in bolts.Welded joints, strength of welded joints, eccentrically loaded joints, welded joints subjected to bending moment and torsion.

UNIT – III

Shafts, keys and couplings –design of rigid and pin bushed flexible couplings.Levers design,Pipes, cylinder and design of pipe joints.

UNIT – IV

Translation screws : force analysis and design of various types of power screws .Springs, uses and design of close coiled helical springs shot pining of springs.Classification Gears,spurgears.

Course Outcomes: At the end of the course, the student shall be able to:

1. Exploration of different concepts & considerations of machine design.
2. Understanding design of different types of mechanical joints.
3. Learning of design of different types of keys & couplings.
4. Design procedure of transmission of shafts.
5. Design of different types springs

Text Books:

1. Maleeve Hartman and O.P.Grover, “Machine Design”, CBS Publication & Publishers
2. V.B. Bhandari, “Machine Design”, Tata McGraw Hill
3. P.C. Sharma and D.K Aggarwal., “Machine Design”, S.K. Kataria & Sons.

Reference Book:

1. Mahadevan, “Design Data Book”, CBS Publishers & Distributors

2. I.E. Shigley & C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co.Inc

Course code	**PCC-MA--305G**				
Category	Professional Core Courses				
Course title	Material science & Metallurgy				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to introduce the student about knowledge of structure of materials and effect of deformation. This paper also provides understanding of heat treatment on materials and applications of different types of alloys and composite materials.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Structure of metal: Crystal structure, miller indices, lattices, imperfections, elementary treatment of point and line defects and their relation to mechanical properties.
Deformation: Slip, twinning, effect of cold and hot working on mechanical properties, principles of recovery, re-crystallization and gain growth.**]**

UNIT - II

Creep: Basic consideration in the selection of material for high and low temperature service, creep curve, effect of material variables on creep properties, brittle failure at low temperature.
Solidification: Phases in metal system, lever rule, solidification of metal and alloys, solid solution, eutectic, eutectoid and inter-metallic compounds, Iron carbon equilibrium diagram, TTT-diagram.

UNIT - III

Heat Treatment: Principles and purpose of heat treatment of plain carbon steels, annealing, normalizing, hardening, tempering, isothermal treatment, case hardening – carburizing, nitriding etc, precipitating hardening of aluminum alloys.
Materials: Plain: Carbon steels, effect of alloying elements, properties, uses, springs, and wear resisting steels, IS standards codes for steels.

UNIT - IV

Corrosion:Types of corrosion, Galvanic cell, rusting of Iron, Methods of protection from corrosion.

Fiber Reinforced Composites: General characteristics, Applications, Introduction to Fibers – glass, carbon, Kevlar 49 fibers. Matrix – Polymeric, Metallic, Ceramic Matrix, Coupling agents and fillers.

Course Outcomes:

1. Student will be able to identify crystal structures for various materials and understand the defects in such structures
2. Understand how to tailor material properties of ferrous and non-ferrous alloys
3. How to quantify mechanical integrity and failure in materials

Text Books:

1. V. Raghavan, "Material Science & Engineering", Prentice Hall India Ltd., 2001.
2. S.K. Hazra Chaudhuri, "Material Science & Processes", Indian Book Publishers, Calcutta, 1983.
3. R.B. Gupta, "Material Science Processes", Satya Prakashan, New Delhi, 2000.

Reference Books:

1. Degarmo E. Paul et.al, "Materials & Processes in Manufacture", Prentice Hall India, New Delhi, 2001.
2. Raymond A Higgim., "Engineering Metallurgy Part 1", Prentice Hall India, New Delhi, 1998.
3. L. Krishna Reddi, "Principles of Engineering Metallurgy", New Age Publication, New Delhi, 2001.
4. Buduisky et al, "Engineering Materials & Properties", Prentice Hall India, New Delhi, 2004.
5. Peter Haasten, "Physical Metallurgy", Cambridge Univ. Press, 1999

Course code	**PCC-MA--307G**				
Category	Professional Core Courses				
Course title	Automatic Control System				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- V**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to facilitate the student with advanced materials in use today and it's application in different type of Industries.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

INTRODUCTION Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function, Modeling of physical systems – Mechanical, Thermal, Hydraulic systems and Electric Networks - Transfer function of DC generator, DC servomotor, AC servomotor ,Potentiometer, Synchros, Tacho- generator, Stepper motor - Block diagram - reduction techniques, Signal flow graph – Mason‟ gain formula. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT-II

TIME DOMAIN ANALYSISStandard Test signals – Time response of second order system - Time domain specifications - Types of systems Steady state error constants - Introduction to P, PI and PID modes of feed back control. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT-III

FREQUENCY DOMAIN ANALYSISF-requency domain specifications - Time and frequency response correlation – Polar plot – Bode plot –All pass minimum phase and non-minimum phase systems. (Related Tutorials Using MATLAB/Simulink – Toolboxes & Functions)

UNIT-IV

SYSTEM STABILITYCharacteristic equation - Routh Hurwitz criterion of stability - Absolute and Relative stability - Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

COURSE OUTCOME.

1.Understanding the principles of operations and characteristics of DC machines
2.Knowledge of electrical transformers and induction motors
3.Know about the different types of induction motors
4.Able to visualise the operation of synchronous motors stepper and sevo motors.
5.Comprehending the power transmission and distributing systems.

Text Books:

1. A.K. Tayal, “Instrumentation and Mechanical Measurement”, Galgotia Publications Pvt. Ltd., 2003.

2. D. Patnabis, “Principles of Industrial Instrumentation”, Tata McGraw Hill, 1998.

3. Nagrath and Gopal, “Control System Engineering”, New Age Publication

4. B.C. Kuo, “Automatic Systems”, Prentice Hall India

Reference Books:

1. T.G. Beckwith, R.D. Maragoni and J.H Lienhard, “Mechanical Measurements”, Addison-Wesley, 1999.

2. E.O. Deoblin, “Measurement Systems, Application and Design”, McGraw Hill Pub. Co., 1999.

3. K.Ogata, “Modern Control Engineering”, Pearson Education

4. Hasan Sayeed, “Automatic Control System”, S.K. Kataria & Sons Publications

Course code	**PCC-MA--309G**				
Category	Professional Core Courses				
Course title	Hydraulic and Pneumatic				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- V**
	3	**1**	**0**	**4**	
Objectives:	The concepts related to database, database techniques, SQL and database operations are introduced in this subject. This creates strong foundation for application data design.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids- Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT-II

HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problem.

UNIT-III

HYDRAULIC CIRCUITS AND SYSTEMS

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe,

Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems. Design of hydraulic circuits for Drilling, Planning, Shaping.

UNIT-IV

PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Design of Pneumatic circuits for Pick and Place applications Introduction to fluidics and pneumatic logic circuits.

COURSE OUTCOME

1. Explain the Fluid power and operation of different types of pumps.
2. Summarize the features and functions of Hydraulic motors, actuators.
3. Explain the different types of Hydraulic circuits and systems

Suggested readings:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill,2001.

3.Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.

4.Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

5.Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995

6.Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.

7.Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.

Course Code	LC-MA-351G				
Category	Professional Core Courses				
Course title	Microprocessors & application Lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of experiments:-

1. Write an ALP to 8086 to perform 16-bit arithmetic operations in various Addressing Modes.
2. Write and execute an ALP to 8086 processor to sort the given 16-bit numbers in Ascending and Descending order.
3. Write an ALP for searching for a number or character in a string for 8086.
4. To write an assembly language program to move the block of data from a source BLOCK to the specified destination BLOCK.
5. Write an ALP for interfacing ADC to 8086.
6. Write an ALP for parallel communication between two microprocessors using 8255.
7. Write an ALP for Arithmetic, logical and bit manipulation operations in 8051.
8. Write an ALP to verify timer/counter operation in 8051.
9. Write an ALP to verify the interrupt handling in 8051.
10. To observe the UART operation in 8051.

Course Outcomes: The students who have undergone the course will be able to understand working of ALP to 8086 to perform 16-bit arithmetics, parallel communication , UART operation in 8051.

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	LC-MA-253G				
Category	Professional Core Courses				
Course title	Machine Design lab				
Scheme and Credits	L	T	P	Credit	
	0	0	4	2	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of experiments:-

The Practicals will involve design of all the elements of the following systems

1. Design of cotter joint

2. knuckle joint

3. pipe Joint

4. screw jack/ Toggle screw jack

5. Rigid and Flexible coupling

6. Spur Gear train

7. Design of shaft.

8. Design of Bearing.

9. Design of Break

10. Design of Clutch.

Course Outcomes: The students who have undergone the course will be able to understand Design of Shaft, Gear & Gear Train ,Clutch etc

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	LC-MA-355G				
Category	Professional Core Courses				
Course title	Control System Lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of experiments:-

1. To Measure load using a load cell on a tutor.
2. Calibrate Linear Variable Differential Transformer (LVDT) for the performance using Micrometer.
3. To determine the elastic constant (modulus of elasticity) of a Cantilever beam subjected to concentrated end load by using STRAIN GUAGES.
4. Measurement of angular displacement using capacitive transducer.
5. Calibrate PHOTO SPEED SENSOR for the performance using MAGNETIC Speed Sensor.
6. Calibrate Pressure Gauge.
7. Calibrate TEMPERATURE SENSORS for the performance using STANDARD water bath.
8. Calibrate Rotameter at different flow rate.
9. Study and calibration of a rotameter for flow measurement.
10. To Study variable capacitance transducer.

Course Outcomes: The students who have undergone the course will be able to understand working of LVDT, Srain Guages, Photo Speed Sensor, Magnetic Speed Sensor etc .

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	LC-MA-357G				
Category	Professional Core Courses				
Course title	Matlab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

LIST OF EXPERIMENT

1. Study of Introduction to MATLAB
2. Study of basic matrix operations
3. To solve linear equation
4. Solution of Linear equations for Underdetermined and Overdetermined cases.
5. Determination of Eigen values and Eigen vectors of a Square matrix.
6. Solution of Difference Equations.
7. Solution of Difference Equations using Euler Method.
8. Solution of differential equation using 4th order Runge- Kutta method.
9. Determination of roots of a polynomial.
10. Determination of polynomial using method of Least Square Curve Fitting.
11. Determination of polynomial fit, analyzing residuals, exponential fit and error bounds from the given data.
12. Determination of time response of an R-L-C circuit.

Course Outcomes: The students who have undergone the course will be able to understand working of CRO , BJT, Amplifier and accessories and understand the basic electronics devices and circuits .

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	PCC-MA-359G				
Category	Professional Core Courses				
Course title	Hydraulic and Pneumatic Lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

LIST OF EXPERIMENTS

1. Simulation of basic hydraulic, pneumatic circuits.
2. Study of Electro pneumatic circuits with PLC.
3. Simulation of electro- pneumatic circuits using microprocessor.
4. Modeling and analysis of basic hydraulic, pneumatic circuits using Software
5. Study of various types of transducers.
6. Study of various signal conditioning circuits.
7. Open and closed loop control of AC and DC drives.
8. Study of PLC and its applications.
9. Study of hydraulic circuit with PLC.
10. Study of VFD(variable frequency drive) its applications.

Course Outcomes: The students who have undergone the course will be able to understand working.

Note: 1. At least ten experiments are to be performed in the Semester. PLC ,VFD,Transducers, Hydraulic & Pneumatic System.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
BACHELOR OF TECHNOLOGY
(Mechanical & Automation Engineering)
SIXTH (6th) SEMESTER EXAMINATION

Sr. No.	Category Course Notation	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assesment	Theory	Practical	Total	
1	Professional Core courses	**PCC-MA-302G**	Management of Manufacturing System	3	1	0	4	4	25	75		100	3
2	Professional Core courses	**PCC-MA-304G**	Machine Design-II	3	1	0	4	4	25	75		100	3
3.	Professional Core courses	**PCC-MA-306G**	Dynamics of Machine	3	1	0	4	4	25	75		100	3
4.	Professional Core courses	**PCC-MA-308G**	Fluid Systems	3	1	0	4	4	25	75		100	3
5.	Professional Core courses	**PCC-MA-310G**	Metal Cutting & Tool Design	3	1	0	4	4	25	75		100	3
6.	Professional Core courses	**LC-MA-352G**	Machine Design-II Lab.	0	2	0	2	1	25		25	50	3
7.	Professional Core courses	**LC-MA-354G**	DOM Lab.	0	2	0	2	1	25		25	50	3
8.	Professional Core courses	**LC-MA-356G**	Fluid Systems Lab	0	2	0	2	1	25		25	50	3
9.	Basic Science course	**LC-MA-358G**	Metal Cutting & Tool Design Lab)	0	2	0	2	1	25		25	50	3
10.	Professional Core courses	**LC-MA-360G**	Prog. IV Lab. (SolidWarks))	0	2	0	2	1	25		25	50	3
TOTAL CREDIT								**25**				**750**	

Course code	**PCC-MA-302G**				
Category	Professional Core Courses				
Course title	Management of manufacturing system				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VI**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to facilitate the student with problems and solutions in managing factory operations.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

.UNIT I:

Introduction: Production functions

Plant Organization: Organization principles of organization, Organization structure-line and staff organization.

Plant Location, Layout: Process layout product layout and combination – methods of layout, economics of layout; group technology.

UNIT II:

Production Planning & Control: Types of products, demand, demand forecasting, marketing strategies, scheduling and control of scheduling production control.

Method Study: Definition and concepts, method study procedures, symbols, advantages, Flow process charts, Motion study, micro motion, SIMO charts, Systems Concepts, Classification analysis techniques.

Work Measurement: Definition, objectives & techniques, Time study equipment, performance rating, allowances, standard time, work sampling, PMTS.

UNIT III:

Industrial Maintenance: Types, organization for maintenance department, Breakdown and preventive maintenance.

Inventory control and replacement analysis: Introduction replacement policy and method adopted, EOQ.

UNIT IV:

Management Concepts: Development of management principles, scientific management, human relation aspects.

Production Cost Concepts: Introduction, cost of production, cost center and unit, classification and analysis of cost, break Even Analysis.

Course Outcome: Student learn concept of Management of manufacturing

1. Understand industrial layout .
2. Knowledge of inventory control and replacement analysis.
3. Understand of production costing.
4. Understand to all types of working chart.

Text Books:

1. S.K. Sharma, “Industrial Engg. & Operation Management”, S.K. Kataria & Sons.
2. Dr. Ravi Shankar, “Industrial Engg. & Management”, Galgotia Publications
3. M. Mahajan, “Industrial Engg. & Production Management”, Dhanpat Rai & Co.

Reference Book:

1. Joseph S. Martinich, “Production & Operation Management”, John Wiley & Sons.

Course code	**PCC-MA--304G**				
Category	Professional Core Courses				
Course title	Machine Design-II				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- VI**
	3	**1**	**0**	**4**	
Objectives:	The primary objective of this course is to demonstrate how engineering design uses the many principles learned in previous engineering science courses and to show how these principles are practically applied. The emphasis in this course is on machine design: the design and creation of devices that consist of interrelated components used to modify force and/or motion				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT I

Design for Production ; Erogonomic and value engineering considerations in design, Role of processing in design, Design considerations for casting, forging and machining.

Variable Loading : Different types of fluctuating/ variable stresses, Fatigue strength considering stress concentration factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation, Problems.

UNIT II

Shafts: Detailed design of shafts for static and dynamic loading, Rigidity and deflection consideration. Springs: Types of Springs, Design for helical springs against tension and their uses, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs, Design Problem

UNIT III

Bearings : design of pivot and collar bearing , Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, types of lubrication – Boundary, mixed and hydrodynamic lubrication, Design of journal bearings using Raimondi and Boyd's Charts, Lubricants and their properties, Selection of suitable lubricants, Design Problems.

UNIT IV

Gears : Classification, Selection of gears, Terminology of gears, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form or Lewis factor for gear tooth, Dynamic load on gear teeth -Barth equation and Buckingham equation and their comparison, Design of spur, helical, bevel & worm gear including the Consideration for maximum power transmitting capacity, Gear Lubrication, Design Problems

Course Outcomes (COs): At the end of the course, the student shall be able to:

1. Understand the Mechanical Design of Elements.
2. Explore the concept of **Friction Clutches & Brakes.**
3. Knowledge of concept of Bearings and Lubrication.
4. Understand to concept of power transmission system.

Text Books:

1. Maleeve Hartman and O.P. Grover, "Machine Design", CBS Publication & Publishers.
2. V.B Bhandari, "Machine Design", Tata McGraw Hill.
3. P.C. Sharma and D.K Aggarwal., "Machine Design", S.K. Kataria & Sons.

Reference Book:

1. Mahadevan, "Design Data Book", CBS Publication & Publishers

Course code	**PCC-MA-306G**				
Category	Professional Core Courses				
Course title	Dyanamic of machine				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- VI**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to facilitate the student with techniques being adopted in industry for inspection and quality checks.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

Static and Dynamic Force Analysis: Static force analysis of planer mechanisms, dynamic force analysis including inertia and frictional forces of planer mechanisms. Dynamics of Reciprocating Engines: engine types, indicator diagrams, gas forces, equivalent masses, inertia forces, bearing loads in a single cylinder engine, crankshaft torque, engine shaking forces.

UNIT-II

Balancing of Rotating Components: static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of rotors, balancing machines, field balancing. Balancing of Reciprocating Parts: Balancing of single cylinder engine, balancing of multi cylinder; inline, radial and V type engines, firing order.

UNIT-III

Governors: introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Dynamometers: types of dynamometers, Prony brake, rope brake and band brake dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer.

UNIT-IV

Gyroscope: gyroscopes, gyroscopic forces and couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

Course Outcomes : At the end of the course, the student shall be able to:

1. Understand the Static and Inertia Force Analysis.
2. Explore the concept of Balancing of rotating and reciprocating masses.
3. Knowledge of concept of Mechanical Governor.
4. Develop the concept of Gyroscope and its application.
5. explore the concept of Mechanical Vibration.

Text Books:

1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok kumar Mallik, Third Edition Affiliated East-West Press.
2. Theory of Machine: S.S. Rattan, McGraw Hill Higher Education.
References:
1. Mechanism and Machine Theory: J.S. Rao and R.V. Dukkipati, New age International.
2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition Mc Graw Hill, Inc .
3. Theory of Machines, Beven, Pearson Indian Education Services, Pvt. Ltd..

Course code	**PCC-MA--308G**				
Category	Professional Core Courses				
Course title	Fluid system				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- VI**
	3	**1**	**0**	**4**	
Objectives:	To introduce the student about Hydraulic Turbines, Reaction Turbines, Centrifugal Pumps and Hydraulic and pneumatic circuits.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Introduction: Euler's equations for turbomachines; impulse and reaction forces due to fluid systems on stationery and moving system of vanes; jet propulsion.

UNIT - II

Water Turbines: Classification; Pelton, Francis, Propeller and Kaplan turbines; velocity triangles; efficiency, draft tubes, governing.

Performance of Fluid Machines: Similarity laws applied to roto-dynamic machines; specific speed, unit quantities, Characteristic curves; use of models; cavitation and attendant problems in turbo-machines; selection of turbines hydroelectric plants.

UNIT - III

Pumps: Centrifugual pumps, velocity triangles; efficiency, turbine pumps; axial and mixed flow pumps.

Hydraulic Power Transmission: Transmission of hydraulic power through pipe lines; water hammer; precautions against water hammer in turbine and pump installations; hydraulic ram.

UNIT - IV

Power Hydraulics: Positive pumps; gear, vane, screw, variable delivery pumps, valves; flow control, pressure control, direction control, solenoid operated valve, hydraulic circuits, (meter-in, meter-out, bleed-off), fluid coupling and torque converter.

Pneumatic Power: Basic principles, comparison of pneumatic and hydraulic Systems.

Course Outcomes: At the end of the course, the student shall be able to:

1.Understand the Euler's equations for turbomachines.

2. Understand the Hydraulic turbine .
3. Conceptualisation of Hydraulic power Transmission.
4. Analyse flows through pipes and open channels.

Text Books:

1. Dr. R.K. Bansal, “Fluid Mechanics & Hydraulic Machines”, Laxmi Publications (P) Ltd., 2002.

Reference Books:

1. Dr. D.S. Kumar, “Fluid Mechanics & Fluid Power Engineering”, S.K. Kataria & Sons,2001

2. D.R. Malhotra & N.K. Malhotra, “The Fluid Mech. & Hydraulics”, Satya Prakashan, 2001

3. V.P. Gupta, Alam Singh, Manish Gupta, “Fluid Mechanics, Fluid Mechanics & Hydraulics”,

Course code	**PCC-MA-_310G**				
Category	Professional Core Courses				
Course title	Metal Cutting & Tool Design				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- VI**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to facilitate the student with theories in metal cutting technology and design aspects of Jigs fixtures and tooling in use today and its application in different type of Industries				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT - I

Introduction: Definition of feed, depth of cut and cutting speed. Concept of specific cutting energy in metal cutting and Numerical based on calculation of machining time on lathe, drilling machine, shaper, milling machine and grinding machines considering specific cutting energy of materials.

Theory of Metal Cutting: Orthogonal and oblique cutting, types of chips, Factors affecting the chip formation, Cutting forces in orthogonal cutting and their measurement, Merchant circle and derivation of relationships between the cutting forces, chip thickness ratio, shear angle, stress and strain in the chip, work done and power required in metal cutting, plowing forces and the 'size-effect', apparent mean shear strength of work material.

UNIT - II

Ernst Merchant Theory:- its assumptions and modifications. Relationship between cutting velocity, shear velocity and chip flow velocity. Mechanism of friction at chip-tool interface. Numericals based on metal-cutting.

Heat generation in Metal cutting: Heat generation and temperature distribution in metal cutting. Calculation of temperature in primary and secondary deformation zones and their measuring methods.

UNIT - III

Machinability: Machinability and its criteria, forms of tool-wear in metal cutting, tool-life and its criteria, effect of different cutting parameters on tool-life. Economics of machining and numericals. Cutting fluids, their physical action and applications.

Grinding: Specifications of grinding wheel, Mechanics of grinding, effect of grinding conditions and type of grinding on wheel behaviour, equivalent diameter of grinding wheel.

UNIT - IV

Cutting Tool Design: General considerations, single point tool geometry. Principles of different cutting tool materials and their important characteristics. Geometry of a drill. Basic principles of design of a single point and multiple point tools i.e broaches and twist drill.

Jigs & Fixtures: Important considerations in jigs and fixture design. Main principles of designing of jigs & fixtures, elements of Jigs and fixtures. Different devices and methods of locations. Different types of clamps used in jigs & fixtures.

Course Outcome: Student learn about machining process & tool Design

1. Understand to all machining process.
2. Understand to knowledge of Grinding process.
3. Knowledge of Cutting Tool Design.
4. Understand to Jigs & Fixtures.

Text Books:

1. Dr. P.C. Pandey & C.K. Singh, "Production Engg. Sciences", Standard Publisher. Distributors.

2. Dr. B.J. Ranganath, "Metal Cutting & Tool Design" Vikas Publishing House Pvt. Ltd.

Reference Books:

1. Geoffrey Boothroyd, "Fundamentals of Metal Machining & Machine Tools", Tata McGraw Hill Kogakusha Ltd.

2. P.N. Rao, "Manufacturing Technology", Tata McGraw Hill Publication Ltd.

Course Code	LC-MA-352G				
Category	Professional Core Courses				
Course title	Machine Design lab-II				
Scheme and Credits	L	T	P	Credit	
	0	0	4	2	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of experiments:-

The Practicals will involve design of all the elements of the following systems.

1. Automotive Transmission (Gear Box)

2. Brakes

3. Clutches

4. Piston of I C Engine

5. Connecting rod of I.C. Engine

6. Mechanical Hoist

7. Hydraulic Riveter 8. Passenger Lift

Course Outcomes: The students who have undergone the course will be able to understand working of

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	LC-MA-354G				
Category	Professional Core Courses				
Course title	Dyanamic of machine Lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

LIST OF EXPERIMENTS:

1. To perform experiment on Watt and Porter Governors to prepare performance characteristic Curves, and to find stability & sensitivity.

2. To perform experiment on Proell Governor to prepare performance characteristic curves, and to find stability & sensitivity.

3. To perform experiment on Hartnell Governor to prepare performance characteristic Curves, and to find stability & sensitivity

. 4. To study gyroscopic effects through models.

5. To determine gyroscopic couple on Motorized Gyroscope.

6. To perform the experiment for static balancing on static balancing machine.

7. To perform the experiment for dynamic balancing on dynamic balancing machine.

8. Determine the moment of inertial of connecting rod by compound pendulum method and triflair suspension pendulum.

Course Outcomes: The students who have undergone the course will be able to understand working Governor, Balancing of Reciprocating Machine etc

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	PCC-MA-356G				
Category	Professional Core Courses				
Course title	Fluid System Lab				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of experiments:-

1.Calibration of Venturi meter.

2 Calibration of Orifice meter.

3 Performance Test on Centrifugal Pump.

4 Performance Test on Reciprocating Pump.

5 To calculate Friction Factor for a given Pipe Line.

6 Impact of jet of water on Vane.

7 Performance Test on Pelton Wheel.

8 Bernoulli's experiment.

9 Performance Test on Francis Turbine.

10 Study working of hydraulic Ram.

Course Outcomes: The students who have undergone the course will be able to understand working of Orifice meter, venture meter, centrifugal Pump, Reciprocating Pump etc.

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	LC-MA--358G				
Category	Professional Core Courses				
Course title	Metal Cutting & Tool Design lab				
Scheme and Credits	L	T	P	Credit	
	0	0	4	2	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

LIST OF EXPERIMENTS:-

1. Designing a single point cutting tool using tool grinder.

2. Measurement and analysis of cutting forces in orthogonal turning for different materials at different speeds.

3. Machining time calculation and comparison with actual machining time while cylindrical turning on Lathe

4. Flank wear – time characteristics for single point cutting tools for different materials at different speeds.

5. Flank wear – time characteristics for single point cutting tools for different materials at different feed and depth of cut.

6. A study of chips formed at different speed, feed, depth of cut, for different materials.

7. To study type of jigs and fixture used in different machines.

8. Testing the main spindle of a lathe for axial movement and true running.

a. Process capability determination of a center lathe.

b. Flatness checking of a surface plate.

9. A study of gear indexing mechanism and using it to cut a gear.

10. Study operation perform on lathe.

11 Study and practice of Orthogonal and Oblique cutting on lathe.

12. Accuracy analysis of finished cylindrical work-pieces produced on a lathe.

Course Outcomes: The students who have undergone the course will be able to understand working of lathe, grinder, single, multicutting tool and its properties.

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	LC-MA--360G				
Category	Professional Core Courses				
Course title	Programming-III(Solid works)				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

CAD MODELING ASSIGNMENTS

CAM Assignments Use and learn import/export techniques and customization of software.

1. Construction of simple machine parts and components like Coupling, Pulley.
2. Construction of simple machine parts and components Crankshaft, Piston , Connecting rod.
3. Construction of simple machine parts and components ,nuts & bolts.
4. Construction of simple machine parts and components gears.
5. Construction of simple machine parts and components helical springs
6. Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice.
7. Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies Drill jigs and Milling fixture
8. Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies Pedestal bearing,
9. Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies of nuckle joint & cotter joint.
10. Make the part family/family table of a bolt. .

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
BACHELOR OF TECHNOLOGY
(Mechanical & Automation Engineering)
SEVENTH (7th) SEMESTER EXAMINATION
w.e.f. Session 2024-25

S.No	Category	Course Code	Course Title	Houre per week			Total contact hrs/week	Credit	Examination Schedule(Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assessment	Th.	Prac.	Total	
1	Professional Elective Course		Professional Elective Course Refer list-I	3	0	0	3	3	25	75		100	3
2	Professional Core courses	PCC-MA--401G	Computer Aided manufacturing	3	0	0	3	3	25	75		100	3
3	Professional Core courses	PCC-MA--403G	Mechatronics	3	0	0	3	3	25	75		100	3
4	Professional Elective Course		Professional Elective Course Refer list-II	3	0	0	3	3	25	75		100	3
5	Practical	LC-MA--451G	Mechatronics Lab	0	0	2	2	1	25		25	50	3
6	Seminar	PCC-MA--453G	Seminar	0	0	2	2	1	25		25	50	3
7	Project	PROJ-MA--455G	Project-1	0	0	6	6	3	25		25	50	3
8	Practical Training	PT-MA--457G	Practical Training-I	0	0	2	2	Refer Note:1(Grading)					
9	Mandatory courses(non-Credit)	MC-317G	Constitution of India	2	0	0	2	Refer Note:2(Grading)					
							Total	**17**	**175**	**300**	**75**	**550**	

Note: 1. The evaluation of Practical Training-II (PT-MAE-457G) will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat .

Practical Training. Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

Note: 2 The students will be awarded grades A, B, C &F in Evaluation of Constitution of India. A student who is awarded 'F' grade is required to repeat.

Note: Students will have to select any one out of the list.

PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VII) LIST-I

S.no	Code	Name of Course	No of contact Hours	Creidt
1	PEC-MA-401G	Refrigration & Air conditioning	3	3
2	PEC-MA-403G	Project Management	3	3
3	PEC-MA-405G	Numeric Control of Machine Tools and Robotics	3	3
4	PEC-MA-407G	Finite element Analysis	3	3

Note: Students will have to select any one out of the list.

PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VII) LIST-II

S.no	Code	Name of Course	No of contact Hours	Creidt
1	PEC-MA-409G	Noise and Vibrations	3	3
2	PEC-MA-411G	Solar Energy Engineering	3	3
3	PEC-MA-413G	Tribology	3	3
4	PEC-MA-415G	Composite materials	3	3

Note: Students will have to select any one out of the list.

Course code	**PCC-MA--401G**				
Category	Professional Core Courses				
Course title	Computer Aided Manufacturing				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**1**	**0**	**4**	
Objectives:	To study of application of CNC in Manufacturing & Computers in planning and scheduling in Manufacturing.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

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UNIT - I

Introduction: Overview of automation in industry. Type of production: continuous, mass, batch and job shop and automation achievements therein. Product cycle and CAD/CAM influence CAD/CAM on product cycle. Automation strategies, mathematical model for employing and justifying CAD/CAM in different areas of operation.

Programmed Automation and Numerical Control: program controlled machine tools, punched card and punched tape machine tools. Numerical control and its basics. Axis designation. NC motion control systems: point-to-point, straight-cut and continuous path control systems. Applications of NC in metal-cutting and non-metal cutting areas.

UNIT - II

Computer numerical control: Block diagrams of CNC operations. Nomenclature, types and features of CNC machine tools. Elements of CNC machines and systems. Machine control unit. Position control and its significance. Engineering analysis of NC positioning systems. Open loop and closed loop systems. Precision in NC positioning systems: control resolution, accuracy and repeatability. Actuators: DC servomotor, ac servomotor, stepper motor. Transducers and feedback elements: resolvers, inductosyns optical grating and encoders.

Introduction and working of AGV(Automated Guided Vehicle) and applications.

UNIT - III

Part programming : Process planning and flow chart for part programming. Tooling systems, tool nomenclature and tool geometries of modern indexable carbide tools. Tool presetting & Modular Tooling. Selection of tools based on machining capacity, accuracy and surface finish. Elements of programming for turning and milling. Composition of a part program. Preparatory codes G, Miscellaneous functions M. Interpolation, Tool compensations, cycles for simplifying programming. Part programming for typical components on turning machines and machining centres.

Computer aided programming: APT Part Programming. Introduction to computer aided programming through Pro-E.

UNIT - IV

Modern CNC machines : CNC lathes. Turning centres. Machining centres. . Automatic pallet changers. Automatic tool changers. Direct numerical control and applications. CNC machine design features. Supporting structures. Guide ways. Ball screw-and-nut mechanisms. Machine spindles. Concept of rigidity and relation with accuracy.

Computer aided Inspection: Coordinate measuring machines and their applications. Introduction to machine vision and applications.

Course Outcome: Student learn to all types of CNC Programming & Operation

1. Understand to NC,CNC & DNC.
2. Understand to Part Programing.
3. Understand to Computer aided Programming.
4. Learn about Computer aided Inspection.

Text Books:

1. Mikell P. Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", 2nd Edition, Pentice Hall, 2001.

2. S.K. Sinha, "CNC Programming", Galgotia Publications 2003.

3. "HMT Mechatronics", Tata McGraw Hill, 2001.

Reference Books:

1. Mikell P. Groover, Emory W.Zimmers, "CAD/CAM", Pearson Education, 2001.

2. P.N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 2003.

Course code	**PCC-MA--403G**				
Category	Professional Core Courses				
Course title	Mechatronics				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**1**	**0**	**4**	
Objectives:	Mechatronics is the combination of mechanical and electronics automation and computers. Nowadays all the mechanical machines have been made computer controlled. The Subject details the basic hardware and software elements used for proper and successful operation of various equipments. The knowledge of this subject will be helpful to students while working in industries.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

. **UNIT - I**

Introduction: Overview: Mechanical Actuation System – Kinematic Chains, Cam, Gear, Train Ratchet Mechanism, Belt, Bearing.

Hydraulic And Pneumatic Actuation Systems: Overview: Pressure Control Valves, Cylinders, Direction Control Valves, Rotary Actuators, Accumulators, Amplifiers, and Pneumatic Sequencing Problems.

UNIT - II

Electrical Actuation Systems: Switching Devices, Mechanical Switches – SPST, SPDT, DPDT, Debouncing keypads; Relays, Solid State Switches, Diodes, Thyristors, Transistors, Solenoid, Types Devices: Solenoid Operated Hydraulic and Pneumatic Vlaves, Electro-Pneumatic Sequencing Problems. Control of DC Motors, Permanent Magnet DC Motors, Control of DC Motors, Bush less Permanent Magnet DC Motors, AC Motors, Stepper Motors, Stepper Motor Controls, Servo Motors.

Interfacing controllers: Interfacing, Buffers, Darlington Pair, I/O Ports, Interface Requirements, Handshaking, Serial and Parallel Port Interfacing, Peripheral Interface, Adapters.

Digital logic: Number Systems, Binary Mathematics, Boolean Algebra, Gates and Integrated Circuits Like 7408, 7402, Karnaugh Maps, Application of Logic Gates as: Parity Generators, Digital Comparators,

BCD to Decimal Decoders, Flip Flops. Introduction to Microcontroller – Intel 8051, Selecting a Microcontroller.

Sensors and transducers and application: Performance Terminology, Static and Dynamic Characteristics, Displacement, Position and Proximity Sensors, Potentiometer Sensors, Strain Gauge Element, LVDT, Optical Encoders, Pneumatic Sensors, Hall Effect Sensors, Tachogenerators, Strain Gauge Load Cell, Thermostats, Photo Darlington. Interfacing Sensors in Mechantronic System as – Temperature Switch Circuit, Float Systems.

UNIT - III

Introduction to signal conditioning: Signal Conditioning Processes, Inverting Amplifiers, Non Inverting Amplifiers, Summing, Integrating, Differential, Logarithmic Amplifiers, Comparators, Amplifiers Error, Filtering, wheatstone Bridge, Temperature Compensation, Thermocouple Compensation, Analog to Digital Conversion, Digital To Analog Conversion, Sample and Hold Amplifiers, Multiplexers, Time Division Multiplexing, Data Acquisition, Digital Signal Processing, Pulse Modulation.

System models: Mechanical System Models Applications like – Machine on a floor, Car Wheel Moving along a road etc. Model Development of an Electrical Systems, Fluid System, and Thermal Systems: Rotational – Translation Systems, DC Motors, Speed Control and Hydraulic – Mechanical Systems.

UNIT - IV

Programmable logic controllers (plc):PLC Structure, Input / Output Processing, Programming, Language (Ladder Diagram), Logic Functions, Latching, Sequencing, Timers, Internal Relays and

Counters, Shift Registers, Master and Jump Controls, Jumps, Data Movement, Code Conversion, Ladder Circuits.

Case studies: Auto-Focus Camera, Printer, Domestic Washing Machine, Optical Mark Reader, Bar Code Reader and Pick and Place robot Arm.

Course Outcome: Student learn about electrical, electronics & Mechanical System.

1. Understand to Hydraulic And Pneumatic Actuation Systems.
2. Knowledge of Sensors and transducers and application.
3. Understand to signal transmitting process.
4. Understand to all Programmable logic controllers.

Text Book:

1. W. Bolton, “Mechatronics”, Pearson Education Ltd., 2003.

Reference Books:

1. Mohammad Ali Mazidi Janice Gillispier Mazidi, “The 8051 Microcontroller”, Pearson Education Inc.,2004.

2. Gary Dunning, “Introduction to Programmable Logic Controllers”, Thomson Asia P. Ltd., Singapore, 1998.
3. Gopal K. Dubey, “Fundamentals of Electrical Drives”, Narosa Publishing House, 2001.
4. Charles H. Roth, “Jr. Fundamentals of Logic Design”, Jaico Publishing House, 2001.
5. "HMT Mechatronics”, Tata McGraw Hill Publishing Co. Ltd., 2001.
6. Devdas Shetty, Richard A. Kolk “Mechatronics System Design”, Thomson Asia Pvt. Ltd., Singapore, 2001.
7. A.K. Tayal, “Instrumentation & Mechanical Measurements”, Galgotia Publication Pvt.Ltd., 2003.
8. D. Rana Durgaiah, “Fluid Mechanics & Machinery”, New Age Int. Publishers, 2004.
9. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts & Application”, Tata McGraw Hill Publishing Co.Ltd., 2003.
10. Mikell P. Groover, “Automation, Production Systems and Computer-Integrated Manufacturing”, 2nd Edition, Prentice Hall, 2001.

Course code	**PEC-MA-401G**				
Category	Professional Elective Courses(Semester – VII)LIST-I				
Course title	Refrigration & Air Conditioning				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**1**	**0**	**4**	
Objectives:	The objective of the paper is to facilitate the student with the basics of Refrigeration & Air conditioning that are required for an engineering student.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

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UNIT-I

Introduction: Definition of refrigeration & air conditioning; Necessity; Methods of refrigeration; Unit of refrigeration; Coefficient of performance (COP), Fundamentals of air-conditioning system; Refrigerants-Definition, Classification, Nomenclature, Desirable properties, Comparative study, secondary refrigerants, Introduction to ecofriendly Refrigerants; Introduction to Cryogenics.

Air Refrigeration System: Carnot refrigeration cycle. Temperature. Limitations; Brayton refrigeration or the Bell Coleman air refrigeration cycle; Necessity of cooling the aero plane; Air craft refrigeration systems, Simple cooling and Simple evaporative types, Boot strap and Boot strap evaporative types, Regenerative type and Reduced Ambient type system, Comparison of different systems, problems.

UNIT-II

Vapour Compression (VC) Refrigeration Systems: (A) Simple Vapour Compression (VC) Refrigeration systemsLimitations of Reversed Carnot cycle with vapour as the refrigerant; Analysis of VC cycle considering degrees of sub cooling and superheating; VC cycle on p-v, t-s and p-h diagrams; Effects of operating conditions on COP; Comparison of VC cycle with Air Refrigeration cycle.

Multistage Ref. Systems- Necessity of compound compression, Compound VC cycle , Inter-cooling with liquid sub –cooling and / or water inter cooler: Multistage compression with flash inter-cooling and / or water inter-cooling; systems with individual or multiple expansion valves; Individual compression system with individual or multiple expansion valves; Individual compression systems with individual or multiple expansion valves but with and without intercoolers.

Other Refrigeration Systems: (A) Vapour Absorption Refrigeration Systems – Basic Systems, Actual COP of the System, Performance, Relative merits and demerits; Properties of aqua ammonia; Electrolux Refrigeration; Problems. Steam Jet Refrigerating System- Introduction, Analysis, Relative merits and demerits, Performance Applications, Problems.

UNIT-III

Psychrometry of Air & Air Conditioning Processes: Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temp., Thermodynamics wet bulb temp., Psychrometric chart; Psychrometry of air-conditioning processes, Mixing Process, Basic processes in conditioning of air; Psychrometric processes in air washer, Problems.

Air- Conditioning Load Calculations: Outside and inside design conditions; Sources of heating load; Sources of cooling load; Heat transfer through structure, Solar radiation, Electrical applications, Infiltration and ventilation, Heat generation inside conditioned space; Apparatus selection; Comfort chart, Problems.

UNIT-IV

Air Conditioning Systems with Controls & Accessories: Classifications, Layout of plants; Equipment selection; Air distribution system; Duct systems Design; Filters; Refrigerant piping; Design of summer air-conditioning and Winter air conditioning systems; Temperature sensors, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories; Problems.

Refrigeration and Air Conditioning Equipments: Type of compressors and their performance curves; Types of Condensers, Heat transfer in condensers; Types of expansion devices; types of evaporators, Cooling and Dehumidifying coils, Problems.

Course Outcomes (COs): At the end of the course, the student shall be able to:

1. Understand the air refrigeration, vapour compression refrigeration, vapour absorption, steam jet refrigeration systems and different type of refrigerants.
2. Expedite the working of single stage, multistage and cascade refrigeration.
3. Knowledge of psychrometry and different psychrometric processes. Understand and evaluate cooling and heating load and design of HVAC system.
4. Develop and design RAC systems and evaluate different expansion and control devices.

Text Books:

1. P L Ballany; “Refrigeration & Air Conditioning”, Khanna Publisher.
2. C.P. Arora, “Refrigeration & Air Conditioning”, Tata McGraw Hill

Reference Books:

1. Domkundewar & Arora, “A Course in Refrigeration & Air conditioning”, Dhanpat Rai & Co.
2. Marsh & Olivo, “Principles of Refrigeration”, C.B.S Publications.
3. Paul Lang, “Principles of Air Conditioning”, C.B.S Publications

Course code	PEC-MA-403G				
Category	Professional Elective Courses (PEC)) (Semester-VII) LIST-I				
Course title	PROJECT MANAGEMENT				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**0**	**0**	**3**	
Objectives:	The students completing this course are expected to understand the concepts of Project Management, how it work.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Project Management :Project Management Concepts, Project Planning, Resource Scheduling, Critical Chain Scheduling, Project Quality Management, Project performance Measurement and Control, Project Closure/ Termination, Managing Project Teams, IT in Projects, International Projects: Issues in managing international projects, Selection and training of employees, cross cultural considerations.

UNIT-II

Theory & Background : Definitions, hard & soft projects, multi project management, program management , project phases, project control project groups. Go/no go decisions.

Idea Phase : Idea selction, development of project contract, determination of project organization, development of project order.

UNIT-III

Defintion Phase : Phase steps : Project description, project results, work breakdown structure, Input management, Project leader ship.

Planning Phase : Development of responsibility matrix, detail project planning, risk & change analysis, arranging input.

UNIT-IV

Implementation Phase : Project monitoring & control, project adjustment, dealing with people. Implementation & After Care : Evaluation and closure of a project.

Course Outcomes (COs):

At the end of the course, the student shall be able to: They properly understand the concepts of Project Management, how it work.

Reference Books:

1. Project Management handbook, Cleland , D.I. and W.R. King, USA.

2. Project Management Body of Knoweldge (PMBOK), Project.

3. Handbook for project oriented organization, Rath S. Hoogland, R. and Turner, J.R.

4. Clifford F Gray, Erik W Larson, “Project Management-The Managerial Process”, Tata Mcgraw-Hill Publishing Co Ltd

5. Jack Meredith, Samuel J. Mantel Jr. “Project Management- A Managerial Approach”, John Wiley and Sons

6. John M Nicholas “Project Management For Business And Technology” Prentice Hall of India Pvt Ltd

7. James P Lewis “Project Planning, Scheduling And Control” Tata Mcgraw-Hill Publishing Co Ltd.

Course code	PEC-MA-407G				
Category	Professional Elective Courses (PEC) (Semester-VII) LIST-I				
Course title	NUMERIC CONTROL OF MACHINE TOOLS AND ROBOTICS				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**0**	**0**	**3**	
Objectives:	The students completing this course are expected to understand the basic knowledge of machine tools and robotics and also automation concepts.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Fundamentals of Numerical Control: Introduction to numerical control, Classification of NC/CNC machines and axis nomenclature, PTP and Continuous Contouring, Absolute and Incremental Programming, Difference between NC and CNC, Different types of software's in CNC.

Control system fundamentals: feedback, transfer function, system stability. Open Loop and Closed Loop control: Servo Mechanism, Position and Velocity feedback.

Engineering Analysis of NC/CNC systems: Computations of total number of pulses and pulse frequency in Open Loop and Closed Loop control, Precision in NC/CNC: Resolution, Accuracy and Repeatability. Interpolation in NC and CNC: Linear and Circular, Tolerance Analysis: Inward, Outward and Secantial. System components: Machine Control Unit (MCU), Transducers, Actuators.

UNIT-II

Design considerations of NC/CNC machine tools: Re-circulating ball screw, lost motions in NC systems, Turning Centers and Machining Centers.

Part Programming: Manual programming: Different G codes and M codes, Stock Removal Cycle, Canned Cycles. Computer assisted Part Programming. Tool path generation from CAD models, CNC Toolings.

Process optimization: Online condition monitoring in CNC, Adaptive control: ACC, ACO & GA. DNC: Direct and Distributed Numerical Control, Merits of DNC, Concept of BTR, Data Multiplexing.

UNIT-III

Automation & Robotics; Spatial Descriptions & Transformations, Manipulator Kinematics – Forward and Inverse; Jacobians: Velocities & Static Forces. Robot Arm Dynamics: Lagrange-Euler formulation of manipulator dynamics. Trajectory Planning: Joint-interpolated trajectories, Geometric problems with Cartesian paths, Collision-free path planning. Robot Control Systems: Feedback and Closed-loop control, Transfer Functions, Control of Second-order systems, Non-linear & time varying systems, Adaptive.

UNIT-IV

Robotic Prehension: Dexterous manipulation; ANN approach in prehension, Sensors in Robotics: Machine vision, Force & Torque sensors. Robot programming: simulators and languages, Tele-robotics and virtual interfaces for task specification and programming, Concept of nanorobotics, Performance analysis of industrial robots and their manufacturing applications, Economics of robotics, Social issues & future of robotics.

Course Outcomes (COs): At the end of the course, the student shall be able to: They properly understand the concepts of basic knowledge of machine tools and robotics and also automation concepts.

Text Book:

1. Robotics for Engineers by Y. Koren, McGraw Hill New York

2. Robotics Technology and Flexible Automation by S.R.Deb, TMH.

3. Numerical Control and Computer Aided manufacturing by R. S. Pressman & J. E. Williams, John Wiley & Sons

4. Computational Geometry for Design and Manufacture, by I. D. Faux and M. J. Pratt, Ellis Horwood, Chichester, 1979. 4. Numerical Control in Manufacturing by F. W. Wilson, McGraw-Hill Book Company New York.

5. Mittal R. K. &Nagrath I. J., “Robotics and Control”, TMH, 2003 (Reprint 2007 or later).

6. Groover, M. P., et al., “Industrial Robotics”, MGHISE, 1986

7. Computer Control of Manufacturing Systems by Y. Koren, McGraw-Hill

8. Industrial Robotic Technology - Programming and Application by M.P.Groover et. al., McGrawHill

9. Robotics: Control, Sensing, Vision and Intelligence by Fu, Lee and Gonzalez, McGraw Hill New York.

Course code	PEC-MA-407G				
Category	Professional Elective Courses (PEC) (Semester-VII) LIST-I				
Course title	FINITE ELEMENT ANALYSIS				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**0**	**0**	**3**	
Objectives:	1. To illustrate the principle of mathematical modeling of engineering problems 2. To introduce the basics and application of Finite Element Method.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

UNIT-II

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

UNIT-III

Two dimensional equations, variational formulation, finite element formulation, triangular elements-shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

UNIT-IV

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

Course Outcomes: Upon completion of the course, students will understand the FEM formulation and its application to simple structural and thermal problems

Text Books:

1. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.

2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.

3. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.

4. Chandraputla&Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

Course code	PEC-MA-409G				
Category	PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VII) LIST-II				
Course title	Noise and Vibrations				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**1**	**0**	**4**	
Objectives:	CO1 - Understand the fundamentals of mechanical vibrations leading to analysis of first degree of freedom CO2 - To introduce the basics concept of two degree of vibration and vibration isolation and transmissibility CO3 - Analyse experimental methods for vibration analysis. CO4 –To learn the influence and stiffness coefficients. CO5 - Analyse the concept of the non-linearity in vibrations and also concept of noise				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Fundamentals : Importance of Study of Vibrations, Classifications of Vibrations, Free and Forced, Undamped and Damped, Linear and Non-linear, Deterministic and Random, Harmonic Motion, Vector and Complex Number Representations, Definitions and Terminology, Periodic Functions, Harmonic Analysis, Fourier Series Expansion. Free and Damped Vibrations : Single Degree of Freedom system, D'Alemberts Principal, Energy Methods, Rayleighs Method, Application of these Methods, Damped Free Vibrations, Logarithmic Decrement, Under Damping, Critical and Over Damping, Coulomb Damping.

UNIT-II

Harmonically Excited Vibrations : Forced Damped Harmonic Vibration of Single Degree of Freedom Systems, Rotating Unbalance, Rotor Unbalance, Critical Speeds and Whirling of Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent, Viscous Camping, Structural Damping Sharpness of Resonance, Vibration Measuring Instruments.

Transient Vibrations : Impulse Excitation, Arbitrary Excitation, Response to Step Excitions, Base Excitation Solution by Laplace Transforms, Response Spectrum, Runge-Kutta Method.

UNIT-III

Two Degrees of Freedom Systems : Introduction to Multi-Degree of Freedom Systems, Normal Mode Vibrations, Coordinate Coupling, Principal Coordinates, Free Vibrations in Terms of Initial Conditions, Forced Harmonic Vibrations, Vibration Absorber, Centrifugal Vibration Absorber, Vibration Damper.

Multi degrees of Freedom Systems and Numerical Methods Introduction, Influence Coefficients, Stiffness Matrix, Flexibility Matrix, Natural Frequencies and Normal Modes, Orthogonality of Normal Modes, Dunkerley's Equation, Method of Matrix Iteration, The Holzer Type Problem, Geared and Branched Systems, Beams.

UNIT-IV

Normal Mode Vibration of Continuous System: Vibrating String, Longitudinal Vibrations of Rod, Torsional Vibrations of Rod, Lateral Vibrations of Beam.

Noise: Noise characteristics, Sources of noise, noise level measurement techniques, vehicular noise level, engine noise, transmission noise, brake squeal, structural noise, noise in auxiliaries, wind noises etc.

Noise Testing & Noise Control:Mechanization of noise generation, noise control methodologies, noise control measures, environmental noise management. Road vehicle noise standards .

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

1. Understand the fundamentals of mechanical vibrations leading to analysis of first degree of freedom.
2. To understand the concept of two degree of vibration and vibration isolation and transmissibility.
3. Analyse experimental methods for vibration analysis.
4. Understanding the influence and stiffness coefficients.
5. Analyse the concept of the non-linearity in vibrations and also concept of noise.

Text Books :

1. Theory of Vibrations with Applications W.T. Thomson, Prentice Hall of India.
2. Mechanical Vibration : G.K. Grover and S.P. Nigam, Nem Chand and Sons
3. Noise, Pollution & Control – S. P. Singal, Narosa Publishing House, New Delhi Reference

Books :

1. Theory and Practice of Mechanical Vibrations J.S. Rao and K. Gupta, Wiley Eastern Ltd.

2. Mechanical Vibrations S.S. Rao, Addison – Wesely Publishing Company.

Course code	PEC-MA-411G				
Category	PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VII) LIST-II				
Course title	Solar Energy Engineering				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**0**	**0**	**3**	
Objectives:	To provide an overview of solar system and the associated energy conversion issues.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Solar Radiation: Introduction, solar system – sun, earth and earth-sun angles, time, derived solar angles, estimation of solar radiation (direct and diffuse), measurement systems – phyrheliometers and other devices. Effect of Solar radiation upon structures: Steady state heat transmission, solar radiation properties of surfaces, shading of surfaces, periodic heat transfer through walls and roofs.

UNIT-II

Solar Collectors: Flat plate and concentrating – comparative study, design and materials, efficiency, selective coatings, heliostats. Heating Applications of Solar Energy: Air and Water heating systems, thermal storages, solar bonds, solar pumps, solar lighting systems, solar cookers, solar drying of grains.

UNIT-III

Cooling Applications of Solar Systems: Continuous and Intermittent vapour absorption systems for cooling applications, absorbent – refrigerant combination, passive cooling systems.

UNIT-IV

Solar Electric Conversion Systems: Photovoltaics, solar cells, satellite solar power systems. Effects on Environment, economic scenario, ozone layer depletion, green house effect, global warming, Remedial measures by international bodies.

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

1. Understand the concept and principles of solar system.
2. Utility and applications of solar system and the associated with energy conversion issues.

3. Understand the concept of solar pump, solar lighting.
4. Understand of effect of green house effect.

Text Books:

1. Solar Energy – S P Sukhatme, Tata McGraw Hill

2. Solar Energy Process – Duffie and Bechman, John Wiley References

Books: 1. Applied Solar Energy – Maniel and Maniel, Addison Wiley

Solar Energy: Fundamentals and Applications – R P Garg and Jai Prakash, TMH .

Course code	PEC-MA-413G				
Category	PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VII) LIST-II				
Course title	TRIBOLOGY				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**0**	**0**	**3**	
Objectives:	The students completing this course are expected to understand the basic concept of tribology and use of engine, wear, friction				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Introduction of Tribology – General tribological considerations in the design of bearings, gears, cams, reciprocating components, etc.

Engine tribology basics - tribology / aspects of engine components such as bearings, piston assembly, valve train and drive train components etc.

UNIT-II

Friction: Natural of metal surfaces – Surface properties – Surface parameters and measurements. Friction – Sliding friction – Rolling friction characteristics of common metals and non-metals – friction under environments. Engine friction – Losses and engine design parameters.

Wear: Economic role of wear – type of wear- wear mechanism, factors affecting wear, selection of materials for different wear situations, measurement of wear, tribometers and tribometry. Engine wear, mechanisms, wear resistance material and coatings and failure mode analysis.

Bearings and Lubrication: Lubricants, type of lubricants, properties and testing, service classification of lubricants, lubrication of tribological components, lubrication system, lubricant monitoring, SOAP, ferrography and other rapid testing methods for lubricants contamination.

UNIT-III

Hydrodynamic Lubrication: Theory of hydrodynamic lubrication, generalized Reynolds equation, slider bearings, fixed & pivoted shoe bearings, hydrodynamic journals bearings, short and finite bearings, thrust bearings, sintered bearing, non-circular bearings and multi side surface bearings.

Externally (Externally – pressurized) lubrication: Hydrostatic bearing, basic concepts, bearing pads, coefficients, restrictors, capillary, orifice and flow control valve, bearing characteristics number and performance coefficients, flat, conical and spherical pad thrust bearing, multi-recess journal and thrust bearings, air and gas lubricated bearings.

UNIT-IV

Elasto – hydrodynamic lubrication: Ball and roller element bearings, classification, selection and life estimation, fatigue, monitoring of ball / roller bearings, diagnostics.

Rheodynamics (Static) lubrication: Non-Newtonian fluids, characteristics, general recommendations of lubricants, SAE & other cloud numbers, thixotopic, materials and Bingham solids, grease lubrication and care stability, tribology components in extreme environments like vacuum, pressure, temperature, tribology matching and selection, tribolo-testing and standards.

Course Outcomes (CO'S): Students would be able :

1. To understand about the basic concept of tribology and use of engine, wear, friction .

Reference Books:

1. Friction and Lubrication, Bowden F.P. & Tabor D., Heinemann Edu. Books Ltd. 1974

2. Friction & Wear of Material, Ernest Rabinowiez

3. Tribology – Handbook, Neal M.J., Butterworth, 1973

4. Standard hand Book of Lubrication Engg., O'Connor J.J. & Boyd J., McGraw Hill, 1968.

5. Theory of Hydro-dynamic Lubrication, Pinkus O, & Sternlincht B., McGraw Hill, 1961.

6. Theory & Practice of Lubrication of Bearing, Fuller D.D., McGraw Hill, 1947.

7. Analysis & Lubrication of Bearings, Shaw M. C., Macks F., McGraw Hill, 1947.

Course code	PEC-MA-415G				
Category	PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VII) LIST-II				
Course title	COMPOSITE MATERIALS				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VII**
	3	**0**	**0**	**3**	
Objectives:	1. To understand the mechanical behaviour of composite materials 2. To get an overview of the methods of manufacturing composite materials and their fabrication methods and testing.				
Class Work	**25 Marks**				
Exam	**75 Marks**				
Total	**100 Marks**				
Duration of Exam	**03 Hours**				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matricespolymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina-assumptions, macroscopic viewpoint, generalized Hooke;s law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness. Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes .

UNIT-II

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, TsaiHill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies

UNIT-III

Fabrication methods: Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films

UNIT-IV

Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.

Course Outcomes (CO'S): Upon completion of this course, the students will have an overview of the mechanical behaviour and application of composite materials and their fabrication methods and testing.
Text Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.

2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998

3. Materials characterization, Vol. 10, ASM hand book

4. Mechanical Metallurgy by G. Dieter Mc-Graw Hill

5. Thermal Analysis of Materials by R.F. Speyer, Marcel Decker

6. Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall India

Course Code	LC-MA-451G				
Category	Professional Core Courses				
Course title	Mechatronics lab				
Scheme and Credits	L	T	P	Credit	
	0	0	4	2	
Class work	25 Marks				
Exam	25Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

LIST OF EXPERIMENT

1. To convert a given hexadecimal number to decimal.

2. To interface a stepper motor with 8051 microcontroller and operate it.

3. To write an assembly language program to simulate the traffic light at an intersection using a traffic light interface.

4. To write an assembly language program to control the speed of DC motor using 8051.

5. To study the circuits of electro pneumatic drives.

6. To study the circuits of Hydraulic drives

7. Conduct the test to control piston cylinder using PLC .

8. Conduct the test to control motor using PLC

9. Conduct the test to simulate Hydraulic drives using PLC

10. Conduct the test to run a circuit for the sequence A+B+A-B- using PLC.

Note: 1. At least ten experiments are to be performed in the Semester.

2 .At least eight experiments should be performed from the above list . Remaining two experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course Code	PCC-MA--453G				
Category	Professional Core Courses				
Course title	SEMINAR				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Objective	To teach the student how to face interview and presentation given and remove their hesitation and improve their communications skills and overall personal developments				
Class work	25				
Exam	25				
Total	50				
Duration of Exam	3				

Selecting of Seminar Topics by Teacher or concerned to teacher by students. A seminar topic given by students in semester.

Course Code	PROJ-MA-455G				
Category	Professional Core Courses				
Course title	PROJECT-I				
Scheme and Credits	L	T	P	Credit	
	0	0	9	4.5	
Objective	This course is aimed to provide more weightage for project work. The project work could be done in the form of a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.				
Class work	25				
Exam	25				
Total	50				
Duration of Exam	3				

The students expected to take up a project under the guidance of teacher from the college. The project must be based on mechanical engineering problems, which can be extended up to the full semester. The students may be asked to work individually or in a group normally not more than four –six students in a group(If any large/big projects occurs then strength of students increases ap per guide supervision). Viva-voce must be based on the preliminary report submitted by students related to the project.

Course Code	PT-MA-457G				
Category	Professional Core Courses				
Course title	PRACTICAL TRAINING				
Scheme and Credits	L	T	P	Credit	
	0	0	9	4.5	
Objective	• Achieving the objectives of the University and its colleges and departments in practical training. • Providing students with practical skills, which match the requirements of the job market and allow them to directly enter the work community in a serious and constructive manner. • Providing students with experience to help them take decisions pertaining to their future career objectives. • Providing college students the full opportunity to apply theoretical knowledge (gained during their studies) in a real work environment at a later stage of their studies. • Developing the student's understanding of the needs of the job market and reaching this understanding successfully.				
Class work	-				
Exam	-				
Total	-				
Duration of Exam	-				

PRACTICAL TRAINING VIVA-VOCE: 1) Assessment of Practical Training-II, undergone at the end of VI semester, will be based on seminar, viva-voce, report and certificate of practical training obtained by the student from the industry/ Professional organization/ Research Laboratory with the prior approval of the Director-Principal/ Mechanical Software /Automobile Workshop. According to performance letter grades A, B, C, F are to be awarded: Excellent : A ; Good : B ; Satisfactory : C ; Not satisfactory : F. A student who has been awarded 'F' grade will be required to repeat the practical training. 2) Each student has to undergo practical training of 4/6 weeks during summer vacation and its evaluation shall be carried out in the VII semester.

Course Code	MC-317G				
Category	Professional Core Courses				
Course title	Constitution of India				
Scheme and Credits	L	T	P	Credit	
	2	0	0	0	

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT-I

Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature of Indian Constitution, Procedure for amendment of the Constitution.

UNIT-II

Federal structure and distribution of legislative and financial powers between the Union and the States

UNIT-III

Organs of Governance: President – Qualification and Powers of the President, GovernorQualification and Powers of Governor, Parliament: Composition, Qualifications and Disqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

UNIT-IV

Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights. Introduction to Right to equality , Right to freedom, Right against exploitation, Right to freedom of religion, Cultural and Education rights and Fundamental duties.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

4. Discuss the passage of the Hindu Code Bill of 1956. The examination of the regular students will be conducted by the concerned college/Institute internally.

References: 1. The Constitution of India, 1950 (Bare Act), Government Publication.

2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition

3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition

4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
BACHELOR OF TECHNOLOGY
(Mechanical & Automation Engineering)
EIGHTH (8th) SEMESTER EXAMINATION
w.e.f. Session 2024-25

S.No	Category	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assesment	Theory	Practical	Total	
1	Professional Core Courses	PCC-ME-402G	Industrial Automation	3	0	0	3	3	25	75		100	3
2	Professional Elective Courses		Refer List-III	3	0	0	3	3	25	75		100	3
3	Professional Elective Courses		Refer List-IV	3	0	0	3	3	25	75		100	3
4	Professional Elective Courses		Refer List-V	3	0	0	3	3	25	75		100	3
5	Open Elective Courses		Refer OEC List-I	3	0	0	3	3	25	75		100	3
6	Practical	LC-MA-452G	Workshop Lab-IV	0	0	2	2	1	25		25	50	3
7	Seminar	PCC-MA-452 G	Seminar	0	0	2	2	1	25		25	50	3
8	Project	PROJ-MA-456G	Project-II	0	0	10	10	5	75		75	150	3
TOTAL								22	250	375	125	750	

Note: Students will have to select any one out of the list.

PROFESSIONAL E ELECTIVE COURSES (PEC) (Semester-VIII) LIST-III

S.No	Code	Name of Cource	No of Contect Hours	Credits
1	PEC-MA-404G	Plant Maintenance Engg	3	3
2	PEC-MA-406G	Design and Optimization of Thermal Energy Systems	3	3
3	PEC-MA-408G	Gas Dynamics and Jet Propulsion	3	3

Note: Students will have to select any one out of the list.

PROFESSIONAL ELECTIVE COURSES(PEC) (Semester- VIII) LIST-IV

S.No	Code	Name of Cource	No of Contect Hours	Credits
1	PEC-MA-412G	Power Plant Engineering	3	3
2	PEC-MA-414G	Product Design and Development	3	3
3	PEC-MA-418G	Introduction to Nanoscience and Nanotechnology	3	3

Note: Students will have to select any one out of the list.

PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VIII) LIST-V

S.No	Code	Name of Cource	No of Contect Hours	Credits
1	PEC-MA-422G	Design of Transmission Systems	3	3
2	PEC-MA-424G	Alternate Fuels and Energy Systems	3	3
3	PEC-MA-416G	Non Conventional Energy Resources Utilization	3	3

Note: Students will have to select any one out of the list.

OPEN ELECTIVE COURSES(OEC)/ HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)-LIST-I

Students have to select any one Open Elective Course-I from the list of courses.

S.No	Code	Name of Cource	No of Contect Hours	Credits
1	OEC –ME-410G	Quality Engineering	3	3
2	OEC-CE- 450G	Disaster Management	3	3
3	HSMC-10G	Management Information Systems	3	3

Note: Students will have to select any one out of the list.

Course code	**PCC-ME-402G**				
Category	Professional Core Courses				
Course title	INDUSTRIAL **AUTOMATION**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	It has been at the forefront of creating new platforms that impact the nation's competitiveness in manufacturing and infrastructure. Automation Industry has been propelling economies internationally by enabling manufacturing and infrastructure to meet the growing needs across the globe. This cross disciplinary segment is the key to enhanced productivity, reliability and quality in multiple domains.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

Material handling systems: Overview of Material Handling Systems-Rotary feeders, oscillating force feeder, Vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

UNIT-II

Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines & Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly.

Control Technologies in Automation: Industrial Control Systems ,Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Sensors, Actuators and other Control System Components.

UNIT-III

Evaluation of automatic production: product manufacturabiiity, orientation devices-active and passive devices, parts orientation and escapement.

Pneumatic and hydraulic components and circuits: Boolean algebra, pneumatic sensors and amplifiers, jet destruction devices, logic devices, schimit triggering devices, developing pneumatic circuits for automatic die casting machine.

UNIT-IV

Modeling and Simulation for manufacturing Plant Automation: Introduction/need for system Modeling, Building. Mathematical Model of a manufacturing Plant, Modern Tools Artificial neural networks in manufacturingautomation, A Iin manufacturing, Fuzzy decision and control, robots and application of robots for automation.

Course Outcomes (COs): At the end of the course, the student shall be able to get practical exposure of Automation Industry has been propelling economies internationally by enabling manufacturing and infrastructure to meet the growing needs across the globe. This cross disciplinary segment is the key to enhanced productivity, reliability and quality in multiple domains.

Reference Books:

1 Hand book of design, manufacturing and Automation: R.C. Dorf, John Wiley and Sons.
2) Automation, Production Systems and Computer Integrated Manufacturing, M. P. Groover, Pearson Education.
3) Industrial Automation: W.P. David, John Wiley and Sons.
4) Computer Based Industrial Control, Krishna Kant, EEE-PHI
5) An Introduction to Automated Process Planning Systems, Tiess Chiu Chang & Richard A.Wysk
6) ManufacturingassemblyHandbook:-Bruno Lotter
7) Anatomy of Automation ,Amber G.H&P.S. Amber, Prentice Hall.
8) PerformanceModelingofAutomatedManufacturingSystems,Viswanandham,PHI.
9) Automatic process control system and Hardware-R.P. Hunter, Prentice Hall

Course code	PEC-MA-404G				
Category	Professional Elective Courses(PEC) (Semester-VIII) (List-III)				
Course title	**PLANT MAINTENANCE ENGG**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities. To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements. To illustrate some of the simple instruments used for condition monitoring in industry				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each
unit.

UNIT-I

Principles and Practices of Maintenance:-Awareness on maintenance and plant engineering maintenance,objectives o maintenance and plant engineering, state of plant, functions and responsibilities; Installation, commissioning, spare part management function, utility and service function, maintenance planning function, physical assets management, Basic Principles of maintenance planning – Planning function in maintenance, maintenance organization, systems of plant engineering and management, decentralization in plant engineering, advantages and drawbacks of decentralization, staffing in plant engineering, Directing, plant engineering and management as integrating function.

UNIT-II

Maintenance Strategies: Introduction, failure based maintenance, contractual maintenance, reliability centered maintenance, Time based maintenance, Condition based maintenance, maintenance strategy, hurdles in formulating maintenance strategy. Maintenance procedure and their selection, characteristics of maintenance strategy.

UNIT-III

Facility Planning and Plant Layout: Introduction, objectives of good facility planning, principles o facility layout, facility location study, facilities governing selection of location, steps in facility location study, plant layout, flow patterns to facilities assembly lines

UNIT-IV

Spare Parts Management: Introduction, features/characteristics of spare parts, functions of spare parts management, classification of spare parts- ABC analysis, SDE Analysis, VED Analysis, CIN Analysis, HML analysis, XYZ analysis, maintenance system optimization, codification, standardization, levels of standards, advantages of standardization, barriers to standardization

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

2. To enable the student to understand the principles, functions and practices adapted in industry for thesuccessful management of maintenance activities.
3. To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
4. To illustrate some of the simple instruments used for condition monitoring in industry.

Text Books:

1. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 1981

2. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995

References Books:

1. White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.
2. Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.
3. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988.
4. Armstrong, "Condition Monitoring", BSIRSA, 1988.
5. Davies, "Handbook of Condition Monitoring", Chapman &Hall, 1996.
6. "Advances in Plant Engineering and Management", Seminar Proceedings - IIPE, 1996

Course code	PEC-MA-406G				
Category	Professional Elective Courses(PEC) (Semester-VIII) (List-III)				
Course title	**Design And Optimization Of Thermal Energy Systems**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	To learn basic principles underlying piping, pumping, heat exchangers; modeling and optimization in design of thermal systems. 2. To develop representational modes of real processes and systems. 3. To optimization concerning design of thermal systems.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

DESIGN CONCEPTS:-Design Principles, Workable Systems, Optimal Systems, Matching of System Components, Economic Analysis, Depreciation, Gradient Present Worth factor, modelling overview – levels and steps in model development - Examples of models – curve fitting and regression analysis .

UNIT-II

MODELLING AND SYSTEMS SIMULATION :-Modelling of thermal energy systems – heat exchanger – solar collectors – distillation - rectification turbo machinery components - refrigeration systems - information flow diagram - solution of set of nonlinear lgebraic equations - successive substitution - Newton Raphson methodexamples of thermal systems simulation

UNIT-III

OPTIMIZATION :-constraints, problem formulation - unconstrained problems - necessary and sufficiency conditions. Constrained optimization - Lagrange multipliers, constrained variations, Linear Programming – Simplex tableau, pivoting, sensitivity analysis - New generation optimization techniques – examples

UNIT-IV

DYNAMIC BEHAVIOUR :- Steady state Simulation, Laplace Transformation, Feedback Control Loops, Stability Analysis, Non-Linearities

APPLICATIONS AND CASE STUDIES :- Case studies of optimization in thermal systems problems- Dealing with uncertainty- probabilistic techniques – Trade-offs between capital and energy using Pinch analysis

Course Outcomes (CO'S): At the end of the course, the student shall be able to: understand modeling and optimization of Thermal systems.

REFERENCES Books:-

1. B.K.Hodge, Analysis and Design of Thermal Systems, Prentice Hall Inc., 1990.
2. Bejan A., George Tsatsaronis , Michael J. Moran , Thermal Design and Optimization, Wiley , 1996.
3. D.J. Wide, Globally Optimal Design, Wiley- Interscience, 1978.
4. Kapur J. N., Mathematical Modelling , Wiley Eastern Ltd , New York , 1989.
5. Rao S. S., Engineering Optimization Theory and Practice, New Age Publishers, 2000.
6. Stoecker W. F., Design of Thermal Systems, McGraw Hill Edition, 1989.
7. YogeshJaluria , Design and Optimization of Thermal Systems , CRC Press , 2007

Course code	PEC-MA-408G				
Category	Professional Elective Courses(PEC) (Semester-VIII) (List-III)				
Course title	**GAS DYNAMICS AND JET PROPULSION**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	1. To understand the features of compressible isentropic flows and irreversibilities like shocks. 2. To provide a basic knowledge of jet and rocket propulsion technologies.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energyequations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow .

UNIT-II

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables.

UNIT-III

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT-IV

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights

Course Outcomes: Upon completion of this course, the students will be able to apply gas dynamics principles to jet and space propulsion systems

Text Books:

1. Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.
2. H.S. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing, 2004.
3. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
4. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.
5. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986

Course code	PEC-MA-412G				
Category	Professional Elective Courses(PEC) (Semester-VIII) (List-IV)				
Course title	**POWER PLANT ENGINEERING**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	To provide an overview of power plants and the associated energy conversion issues				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants. Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydroelectric power plants, site selection, comparison with other types of power plants.

UNIT-II

Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator. Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gasturbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.

UNIT-III

Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU,Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.

Power Plant Economics: load curve, different terms and definitions, cost of electrical energy, tariffs methods ofelectrical energy, performance & operating characteristics of power plants- incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing, Problems.

UNIT-IV

Non-Conventional Power Generation: Solar radiation estimation, solar energy collectors, low, medium & high temperature power plants, OTEC, wind power plants, tidal power plants, geothermal power plants.

Direct Energy Conversion Systems: Fuel cell, MHD power generation-principle, open & closed cycles systems, thermoelectric power generation, thermionic power generation.

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

5. Understand the principles of steam power plants and gas power plants.
6. Utility and applications of nuclear power plant.
7. Installation and commissioning of hydro-electric power plants.
8. Understand various factors affecting non-conventional power plant.

9. understand the principles of operation for different power plants and their economics.

Text Books :

1. Power station Engineering and Economy by Bernhardt G.A. skrotzki and William A. Vopat – Tata Mc Graw Hill
Publishing Campany Ltd., New Delhi
2. Power Plant Engineering : P.K. Nag Tata McGraw Hill second Edition 2001.

Reference Books :

1. Power Plant Engg. : M.M. El-Wakil McGraw Hill 1985.

<table>
<tr><td>Course code</td><td colspan="5">PEC-MA-414G</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective Courses(PEC) (Semester-VIII) (List-IV)</td></tr>
<tr><td>Course title</td><td colspan="5">PRODUCT DESIGN AND DEVELOPMENT</td></tr>
<tr><td rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">Semester-VIII</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Objectives:</td><td colspan="5">The objective of product development is to cultivate, maintain and increase a company's market share by satisfying a consumer demand. Not every product will appeal to every customer or client base, so defining the target market for a product is a critical component that must take place early in the product development process. Quantitative market research should be conducted at all phases of the design process, including before the product or service is conceived, while the product is being designed and after the product has been launched.</td></tr>
<tr><td>Class work</td><td colspan="5">25 Marks</td></tr>
<tr><td>Exam</td><td colspan="5">75 Marks</td></tr>
<tr><td>Total</td><td colspan="5">100 Marks</td></tr>
<tr><td>Duration of Exam</td><td colspan="5">03 Hours</td></tr>
</table>

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

DESIGN PROCESS – The design process - Morphology of Design - Design drawings - Computer Aided Engineering - Designing of standards - Concurrent Engineering - Product life cycle - Technological Forecasting -Market Identification - Competition Bench marking - Systems Engineering - Life Cycle Engineering – Human Factors in Design - Industrial Design.

UNIT-II

DESIGN METHODS – Creativity and Problem Solving - Product Design Specifications - Conceptual design -Decision theory - Embodiment Design - Detail Design - Mathematical Modeling - Simulation - Geometric Modeling- Finite Element Modeling - Optimization - Search Methods - Geometric Programming - Structural and Shape Optimization.

UNIT-III

INTRODUCTION TO SOLID MECHANICS: Stress, Strain in 2-d and 3-d, relation between stress and strain, theories of failure.

MATERIAL SELECTION PROCESSING AND DESIGN – Material selection Process - Economics - Cost Vs Performance - Weighted property Index - Value Analysis - Role of Processing and Design - Classification of Manufacturing Process - Design for Manufacture - Design for Assembly - Design for castings, Forging, Metal Forming, Machining and Welding - Residual stresses - Fatigue, Fracture and Failure.

UNIT-IV

ENGINEERING STATISTICS AND RELIABILITY – Probability - Distributions - Test of Hypothesis – Design of Experiments - Reliability Theory - Design of Reliability - Reliability centered Maintenance.

QUALITY ENGINEERING – Total Quality Concept - Quality Assurance - Statistics Process Control – Taguchi Methods - Robust Design - Failure Model Effect Analysis.

Course Outcomes (CO'S): At the end of the course, the student shall be able to: to understand how product development is to cultivate, maintain and increase a company's market share by satisfying a consumer demand. They know, how quantitative market research should be conducted at all phases of the design process, including before

the product or service is conceived, while the product is being designed and after the product has been launched.

Text Books:

1. Dieter George E., "Engineering Design – A Materials and Processing Approach", McGraw Hill, International

Edition Mechanical Engg ., Series ,1991.

2. Karl t. Ulrich and Steven d Eppinger "Product Design and Developement " ,McGraw Hill,Edition 2000.

3. Palh .G. and Beitz .W., " Engineering Design ", Springer - Verlag , NY. 1985. 4. Ray .M.S., " Elements of Engg.

Design ", Prentice Hall Inc . 1985.

5. Suh .N.P. , " The Principle of Design ", Oxford University Press , NY. 1990

Course code	PEC-MA-418G				
Category	Professional Elective Courses(PEC) (Semester-VIII) (List-IV)				
Course title	**INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	To introduce nanotechnology and nanostructures . To introduce fabrication and characterization techniques used in nanotechnology				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Background to Nanoscience: Defination of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challengs of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.

UNIT-II

Types of nanostructure and properties of nanomaterials: One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanicalphysical- chemical properties.

UNIT-III

Application of Nanomaterial: Ferroelectric materials, coating, molecular electronics and nanoelectronics, biological and environmental, membrane based application, polymer based application.

UNIT-IV

Nanomachines: covalent and non covalent approaches, Molecular motors and machines, molecular devices, single

molecular devices, practical problems with molecular deviceNanofluids: nanoparticles, preparation of nanofluids, thermophysical properties of nanofluids in comparison with base fluid. Nanoswitches - nano computers- nanofilters

Course Outcomes : At the end of the course, the student shall be able to:

2. Understand properties of materials at nanoscale
3. Know the fabrication and characterization methods used in nanotechnology
4. Acquaint with the various applications of nanotechnology.

Text books:

1. A.K. Bandyopdhyay, Nanomaterials, , New age international publishers,2008
2. Bharat Bhushan, Springer Handbook of Nanotechnology, 2010 Charles P Poole, Frank J Owens, Introduction to Nanotechnology, John Wiley and Sons, 2003
3. Jeremy Ramsden,Nanotechnology, William Andrew, Elsevier, 2011
4. T Pradeep, Nano: The essentials, McGraw – Hill education,2 007
5. V.S.Muralidharan, A Subramnya,Nano science and Technology, Ane books Pvt Ltd

Reference books:

1. Gregory Timp, Nanotechnology, Springer-Verlag, 2009
2. John Mongillo, Nano Technology, Greenwood Press, 2007
3. Kelsall Robert. W, Ian Hamley, MarkGeoghegan, Nanoscale Science and Technology, Wiley Eastern,2005
4. Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.
5. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
6. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830-831, Cambridge University Press.
7. Processing & properties of structural naonmaterials - Leon L. Shaw, Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005

Course code	PEC-MA-422G				
Category	Professional Elective Courses (PEC) (Semester-VIII) (List-V)				
Course title	**DESIGN OF TRANSMISSION SYSTEMS**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	To learn about the design procedures for mechanical power transmission components Contents: Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

UNIT-II

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

UNIT-III

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

UNIT-IV

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Course Outcomes: Upon completing this course the students will be able to design transmission systems for engines and machines.

Text Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill,2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001

Course code	PEC-MA-424G				
Category	Professional Elective Courses (PEC) (Semester-VIII) (List-V)				
Course title	Alternate Fuels and Energy Systems				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	To learn about the design procedures for mechanical power transmission components Contents: Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Estimation of petroleum reserve-Need for alternate fuel-Availability and properties of alternate fuelsgeneral use of alcohols- LPG-Hydrogen-Ammonia, CNG, and LNG-Vegetable oils and Biogas-Merits and demerits of various alternate fuels.

UNIT-II

Alcohols: Properties as engine fuels, alchohols and gasoline blends-Combustion characteristics in engines-emission characteristics. Vegetable Oils: Various vegetable oils for engines Esterification-Performance in engines- Performance and emission characteristics

UNIT-III

Natural Gas, LPG, Hydrogen and Biogas: Availability of CNG, properties modification required to use in enginesperformance and emission characteristics of CNG using LPG in SI & CI engines. Performance and emission for LPG-Hydrogen-Storage and handling, performance and safety aspects.

UNIT-IV

Electrical and Solar Powered Vehicles: Layout of an electric vehicle-Advantage and limitationsSpecifications-System component, Electronic control system-High energy and power density batteries-Hybrid vehicle-Solar powered vehicles.

Course Outcomes (COs): At the end of the course, the student shall be able to: understand how the fuel is to store energy, which should be in a stable form and can be easily transported to the place of use. Almost all fuels are chemical fuels. The user employs this fuel to generate heat or perform mechanical work, such as powering an engine. It may also be used to generate electricity, which is then used for heating, lighting, or other purposes.

Reference Books :

1. Maheswar Dayal, Energy today & tomorrow, I & B Horishr India,1982
2. Nagpal, Power Plant Engineering, Khanna Publishers,1991.
3. Alchohols and Motor fuels progress in technology, Series No.19,SAEPublicartion USA 1980.
4. SAE paper Nos.840367, 841156,841333,841334.

Course code	**PEC-MA-416G**				
Category	Professional Elective Courses (PEC) (Semester-VIII) (List-VI)				
Course title	**NON CONVENTIONAL ENERGY RESOURCES UTILIZATION**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	The main purpose of fuel is to store energy, which should be in a stable form and can be easily transported to the place of use. The user employs this fuel to generate heat or perform mechanical work, such as powering an engine. It may also be used to generate electricity, which is then used for heating, lighting, or other purposes.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Principles Of Solar Radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II

Solar Energy Collection:Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

UNIT-III

Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, principles of DEC. Thermoelectric generators, seebeck, peltier and joul Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD

Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faradays laws, thermodynamic aspects, selection of fuels and operating conditions.

UNIT-IV

Bio-Mass:Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects..

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Course Outcomes (COs): At the end of the course, the student shall be able to: understanding of fuel is to store energy, which should be in a stable form and can be easily transported to the place of use. The user employs this fuel to generate heat or perform mechanical work, such as powering an engine. It may also be used to generate electricity, which is then used for heating, lighting, or other purposes.

Reference Book:

1. Renewable energy resources/ Tiwari and Ghosal/Narosa.
2. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.
3. Non-Conventional Energy Systems / K Mittal/Wheeler

Text books:

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “Energy Resources: Conventional & Non-Conventional” BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International.
5. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle,“ Renewable Energy Power For A Sustainable Future”, Oxford University Press

Course code	OEC-ME-410G				
Category	Open Elective Courses (OEC) (Semester-VIII) List-III				
Course title	**QUALITY ENGINEERING**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	To understand the concept of Quality Engineering which emphasizes growth, creativity, and analytical thinking				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit

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UNIT-I

Basic Concepts of Quality: Definitions of Quality and its importance in industry, Quality function, Quality Characteristics, Quality process, Quality Traits, Applications of Quality Concept, Introduction to quality control, Computer aided quality control, Total quality control(TQC) and its implementation, Elements of TQC, Quality Circle, Objectives of quality circle, Role of management in quality circle, Quality in service organizations, characteristics of a service organization, Important service dimensions, Design of service quality.

UNIT-II

Basic Statistical Concepts: The Concept of variation, Distinction between variables and attributes data, The frequency distribution, graphical representation of frequency distribution, Quantitative description of distribution, the normal curve, concept of probability, laws of probability, probability distributions, hyper geometric distribution,binomial distribution, The Poisson distribution.

UNIT-III

Quality systems: Quality systems, Need for quality System, Need for standardization, History of ISO:9000 series standards and its features, steps to registration, India and ISO:9000, Automated inspection systems technologies, Different forms of Inspection, Industrial inspection,

UNIT-IV

Total Quality Management: Introduction o TQM, Concepts, Characteristics of TQM, Relevance of TQM, Approaches to TQM Implementation, TQM philosophies, Taguchi Philosphy, JIT, Kaizen, Six Sigma approach, 5-S approach

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

1. Attain the basic techniques of quality improvement, fundamental knowledge of statistics and probability
2. Use control charts to analyze for improving the process quality.
3. Describe different sampling plans

4. Acquire basic knowledge of total quality management.
5. Understand the modern quality management techniques.

Text Books:

1. Quality planning and Analysis, Juran and Gryna, TMH, New Delhi
2. Quality Management, Kanishka Bed, Oxford University Press, New Delhi
3. Introduction to SQC, Montgomery DC, 3e, Wiley, New Delhi
4. Fundamentals of quality control and improvement, A Mitra, Mcmillan pub. Company, NY

Reference Books:

1. Fundamentals of Applied Statistics, Gupta and Kapoor, Sultan Chand and Sons, New Delhi.

Course code	**OEC-CE- 450G**				
Category	Open Elective Courses (OEC) (Semester-VIII) List-IV				
Course title	**Disaster Management**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	□□To provide basic conceptual understanding of disasters and its relationships with development. □□Provide an understanding of the social nature of natural hazards and disasters □□Increase awareness of hazards and disasters around the world and the unequal social consequences stemming from disaster events				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Introduction: Terminology,Global and Indian scenario, role of engineer, importance of study in human life, long term effects of disaster. Geological Mass Movement and land disasters, Atmospheric disasters, Disaster Mitigation

Unit-II

Natural Disaster: Nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion

Man-made Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit -III

Case Studies: Damage profile analysis- Uttarkashi/Bhuj/Latur earthquakes, Kerala floods, cyclone Fani and Amphan, Bihar floods, Covid 19.

Unit IV

Disaster Management: Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Applications of GIS, Remote sensing and GPS in this regard.

COURSE OUTCOMES:

After completing this course, students should be able:

1. To know natural as well as manmade disaster and their extent and possible effects on the economy.
2. To Plan national importance structures based upon the previous history.
3. To acquaint with government policies, acts and various organizational structures associated with an emergency.
4. To know the simple dos and don’ts in such extreme events and act accordingly.

REFERENCE BOOKS:

1. Singhal J.P. Disaster Management, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-

9380386423
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-
10: 1259007367, ISBN-13: 978-1259007361]
2. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi,2011

Course code	HSMC-10G				
Category	Humanities And Social Sciences Including Management Courses (HSMC)- (Semester-VIII) List-I				
Course title	**MANAGEMENT INFORMATION SYSTEM**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	Its main goals are to help an organization's executives make decisions that improve the organization's agenda and incorporate the company's organizational structure and dynamics to better leverage the organization for a competitive advantage.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

UNIT-I Foundation of Information Systems: Introduction to information system in business, 8 fundamentals of information systems, Solving business problems with information systems, Types of information systems, Effectiveness and efficiency criteria in information system.

UNIT-II

An overview of Management Information Systems: Definition of a management 8 information system, MIS versus Data processing, MIS & Decision Support Systems, MIS & Information Resources Management, End user computing, Concept of an MIS,Structure of a Management information system.

UNIT-III

Concepts of planning: Concept of organizational planning, The Planning Process, 8 Computational support for planning. Business applications of information technology: Internet & electronic commerce and its applications Enterprise Solutions ,Information System for Business Operations(SDLC),Information System for Strategic Advantage, Decision Support Systems and its benefits and characteristics.

UNIT-IV

Managing Information Technology: Enterprise & global management, Security & 8 Ethical challenges, Planning & Implementing changes. Advanced Concepts in Information Systems: Enterprise Resource

Planning, Supply Chain Management, Customer Relationship Management, and Procurement Management.

Course Outcomes (COs):

1. Upon successful completion of this course, students will be able to
2. Understand the leadership role of Management Information Systems in achieving business competitive advantage through informed decision making.
3. Analyze and synthesize business information and systems to facilitate evaluation of strategic alternatives.
4. Effectively communicate strategic alternatives to facilitate decision making.

Text Book:

1. O Brian, “Management Information System”, TMH
2. Gordon B. Davis & Margrethe H. Olson, “Management Information System”, TMH
3. Ravi Kalakota, Andrew Winston, “Frontiers of Electronic Commerce”, Addison Wesley.

Refrence Books:-

1. O Brian, “Introduction to Information System”, MCGRAW HILL.
2. Murdick, “Information System for Modern Management”, PHI.
3. Jawadekar, “ Management Information System”, TMH.
4. Jain Sarika, “Information System”, PPM
5. Davis, “Information System”,

Course code	LC-MA-452-G				
Category	Practical				
Course title	**Workshop Lab-IV**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	0	0	2	2	
Objectives:	Its main goals are to help an organization's executives make decisions that improve the organization's agenda and incorporate the company's organizational structure and dynamics to better leverage the organization for a competitive advantage.				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	4 Hours				

List of Experiments :

1. To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems. (a) Multi-cylinder : Diesel and Petrol Engines. (b) Engine cooling & lubricating Systems. (c) Engine starting Systems. (d) Contact Point & Electronic Ignition Systems.

2. To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems: (a) Carburetors (b) Diesel Fuel Injection Systems (c) Gasoline Fuel Injection Systems.

3. To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches. (a) Coil-Spring Clutch (b) Diaphragm – Spring Clutch. (c) Double Disk Clutch.

4. To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems. (a) Synchromesh – Four speed Range. (b) Transaxle with Dual Speed Range. (c) Four Wheel Drive and Transfer Case. (d) Steering Column and Floor – Shift levers.

5. To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials. (a) Rear Wheel Drive Line. (b) Front Wheel Drive Line. (c) Differentials, Drive Axles and Four Wheel Drive Line.

6. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems. (a) Front Suspension System. (b) Rear Suspension System.

7. To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems. (a) Manual Steering Systems, e.g. Pitman –arm steering, Rack

& Pinion steering. (b) Power steering Systems, e.g. Rack and Pinion Power Steering System. (c) Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.

8. To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres & wheels. (a) Various Types of Bias & Radial Tyres. (b) Various Types of wheels.

9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems. (a) Hydraulic & Pneumatic Brake systems. (b) Drum Brake System. (c) Disk Brake System. (d) Antilock Brake System. (e) System Packing & Other Brakes.

10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.

11. Modeling of any two automotive systems on 3D CAD using educational softwares (eg. 3D modeling package/Pro Engineering/I-Deas/ Solid edge etc.)

12. Crash worthiness of the designed frame using Hypermesh and LS-Dyna solver or other software.

Course Outcomes : At the end of the course, the student shall be able to get practical exposure of: 1- Principle of automobiles drive and advances in automobiles.
2- Various types of clutch.
3- Various types of steering system along with merits and demerits.
4- Various type of hybrid vehicles.
5- Hydrogen based technology for pollution control

Note : 1. At least ten experiments are to be performed in the Semester.

2. At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or as designed & set by the concerned institution as per the scope of the syllabus.

Course Code	PCC-MA--452G				
Category	Professional Core Courses				
Course title	SEMINAR				
Scheme and Credits	L	T	P	Credit	
	0	0	2	1	
Objective	To teach the student how to face interview and presentation given and remove their hesitation and improve their communications skills and overall personal developments				
Class work	25				
Exam	25				
Total	50				
Duration of Exam	3				

Selecting of Seminar Topics by Teacher or concerned to teacher by students. A seminar topic given by students in semester.

Course Code	PCC-MA--456G				
Category	Professional Core Courses				
Course title	PROJECT-II				
Scheme and Credits	L	T	P	Credit	
	0	0	9	4.5	
Objective	This course is aimed to provide more weightage for project work. The project work could be done in the form of a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.				
Class work	25				
Exam	25				
Total	50				
Duration of Exam	3				

The students expected to take up a project under the guidance of teacher from the college. The project must be based on mechanical engineering problems, which can be extended up to the full semester. The students may be asked to work individually or in a group normally not more than four –six students in a group(If any large/big projects occurs then strength of students increases ap per guide supervision). Viva-voce must be based on the preliminary report submitted by students related to the project.