PEOPLE'S UNIVERSITY, BHOPAL
(Applicable for Admitted from Academic Session 2019-20 onwards)

Programme: **B. Tech. (Mechanical Engineering)**   Semester –VII

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P	External (70)	Internal (30)	Total (100)	External	Internal	Total
MET-17101	**Value Engineering**	3	1	-			Min: 40 (D Grade)	Nil	Nil	Nil

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks: 20	Assignment/Quiz/Attendance- Max. Marks: 10
Practical Internal Max Marks: - Nil	Lab work & Sessional – Max Marks: -Nil	Assignment / Quiz/attendance- Max. Marks: -Nil

Pre-Requisite	Nil
Course Outcome	1. Students will understand the techniques and applications of Value Engineering.
	2. Ability to understand the concept of Value Engineering and Value Analysis.

Unit	Content (Theory)	Marks Weightage
I	**Value Engineering Concepts:** Advantages, applications in product development, process improvement, service improvement and system design, problem recognition, role in productivity, criteria for comparison, elements of choice.	14
II	**Analysis of Functions:** Anatomy of function; Values: Use, antique, cost, esteem and exchange; Primary versus secondary versus tertiary/unnecessary functions; Functional Analysis: Function Analysis System Technique and quantitative evaluation of ideas, case studies.	14
III	**Value Engineering Techniques:** Selecting products and operations for VE action, timing; VE programmes, determining and evaluating functions, assigning rupee equivalents, developing alternate means to required functions, decision making for optimum alternative, Queuing theory and Monte Carlo method, make or buy, Measuring profits, Reporting results, Follow up, Use of advanced technique like FAST, use of decision matrix, make or buy decisions, measuring profits, reporting results and follow up	14
IV	**Implementation:** Action plan, record progress, report progress, review meetings, problems in implementation, human factors	14
V	**Managing VE:** Level of VE in the organization, size and skill of VE staff, small plant VE activity management supports; Audit of savings.	14

Text Book/References Books/ Websites:

1. Miles; Techniques of Value analysis and engineering; McGraw Hill Publication.
2. Heller Pub; Value Management; Addison Wesley.
3. Loughton; Value Analysis and Value; Pitman Publication.

Suggested List of Laboratory Experiments: (Expandable):- Nil

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		L	**T**	**P**	**External (70)**	**Internal (30)**	**Total (100)**	**External**	**Internal**	**Total**
MET-17102	**Computer Aided Engineering**	3	1	-			**Min: 40 (D Grade)**	Nil	Nil	Nil

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks: 20	Assignment/Quiz/Attendance-Max. Marks: 10
Practical Internal Max Marks: - Nil	Lab work & Sessional – Max Marks: -Nil	Assignment / Quiz/attendance-Max. Marks: -Nil

Pre-Requisite	Nil
Course Outcome	1. Students will understand the basics of Drawing.
	2. They will learn to design and implement its procedure for designing different component of machines.

Unit	Content (Theory)	Marks Weightage
I	**Introduction:** Methods to solve engineering problems- analytical, numerical, experimental, their merits and comparison, Computer Aided Engineering (CAE) and design, chain, stages vs concurrent-collaborative design cycles, computer as enabler for concurrent design , Structural analysis, objectives, static, Dynamic and kinematics analyses, Basic steps in finite element problem formulation, General applicability of the method , importance of meshing, boundary conditions, degree of freedom (DOF).	**14**
II	**Element Types and Characteristics:** Types of analysis in CAE, static (linear/ non linear), dynamic, buckling, thermal, fatigue, crash NVH and CFD, Basic element shapes, Aspect ratio, Shape functions, Generalized co-ordinates and nodal shape functions; ID bar and beam elements, 2D rectangular and triangular elements; axis-symmetric elements , meshing in elements and length of elements.	**14**
III	**Assembly of Elements and Matrices:** Concept of element assembly, Global and local coordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, force stiffness and displacement matrix, Rayleigh-Ritz and Galerkin method, FEM; analytical and FEM solution for single rod element and two rod assembly. Solution of simultaneous equations, Gaussian elimination and Choleksy decomposition methods, Numerical integration, One and 2D applications.	**14**
IV	**Static Analysis:** Analysis of trusses and frames, Analysis of machine subassemblies, Use commercial software packages, Advantages and limitations	**14**
V	**Dynamic Analysis:** Hamilton's principle, Derivation of equilibrium, Consistent and lumped mass matrices, Derivation of mass matrices for ID elements, Determination of natural frequencies and mode shapes, Use of commercial software packages.	**14**

Text Book/References Books/ Websites:

1. David Hutton; Fundamentals of finite Element Analysis; TMH.
2. T.R. Chandrapatla and Belegundu; Finite element in engineering; Dhanpat Prakashan.
3. Krishnamurthy; Finite Element Analysis, theory and programming; TMH
4. Seshu; Textbook of Finite Element Analysis; PHI.

Suggested List of Laboratory Experiments: (Expandable):- Nil

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	**T**	**P**	**External (70)**	**Internal (30)**	**Total (100)**	**External**	**Internal**	**Total**
MET-17103	**Automobile Engineering**	3	1	-			Min: 40 (D Grade)	Nil	Nil	Nil

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks: 20	Assignment/Quiz/Attendance- Max. Marks: 10
Practical Internal Max Marks: - Nil	Lab work & Sessional – Max Marks: -Nil	Assignment / Quiz/attendance- Max. Marks: -Nil

Pre-Requisite	Nil
Course Outcome	1. Students will understand the working principal of Automobile Parts.
	2. To understand the various types of engines and their fuel properties.

Unit	Content (Theory)	Marks Weightage
I	**Chassis & Body Engineering:** Types, Technical details of commercial vehicles, types of chassis, layout, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, driver's cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive	**14**
II	**Steering System:** Front axle beam, stub axle, front wheel assembly, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe-out, condition for true rolling motion, centre point steering, directional stability of vehicles, steering gear, power steering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears. **Emission standards and pollution control:** Indian standards for automotive vehicles-Bharat I and II, Euro-I and Euro-II norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine efficiency and emission control.	**14**
III	**Transmission System:** Function and types of clutches, single plate, multi-plate clutch, roller & spring clutch, clutch lining and bonding, double declutching, types of gear Boxes, synchroniser, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction.	**14**
IV	**Suspension system** : Basic suspension movements, Independent front & rear suspension, shock absorber, type of springs: leaf spring, coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque & mechanical efficiency at different vehicle speeds, weight transfer, braking systems, disc theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-Energisation, air bleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and material properties of tyres & tubes.	**14**
V	**Electrical and Control Systems:** Storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, Lighting system, head light dazzling, signalling devices, battery operated vehicles, choppers. Importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems.	**14**

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Text Book/References Books/ Websites:
1. Crouse; Automotive Mechanics; TMH.
2. S Srinivasan; Automotive engines; TMH.
3. HN Gupta; Internal Combustion Engines; PHI.
4. Kripal Singh; Automotive Engineering Khanna Publication.
5. Emission standards from BIS and Euro –I and Euro-III.

Suggested List of Laboratory Experiments: (Expandable):- Nil

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P	External (70)	Internal (30)	Total (100)	External	Internal	Total
MET-1702	Robotics and Industrial Automation	3	1	-			Min: 40 (D Grade)	Nil	Nil	Nil

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks: 20	Assignment/Quiz/Attendance-Max. Marks: 10
Practical Internal Max Marks: - Nil	Lab work & Sessional – Max Marks: -Nil	Assignment / Quiz/attendance-Max. Marks: -Nil

Pre-Requisite	Nil
Course Outcome	3.Students will understand the techniques and applications of Automation and Robotics Programming
	4.They will learn to design and implement robotic systems and apply what they learned to a career in the Automation and Robotics field

Unit	Content (Theory)	Marks Weightage
I	**Introduction:** Need and importance, basic concepts, structure and classification of industrial robots, terminology of robot motion, configuration, anatomy, specifications of robot system, applications.End Effectors and Drive systems: Drive systems for robots, salient features and comparison, different types of end effectors, design, and applications.	14
II	**Sensors:** Classifications, features, characteristics, types, piezoelectric, linear position, displacement, proximity, tactile, vision, voice, optical ,range, sensors, encoders, image processing & object recognitions, types of Robot Programming method, programming concepts and types of programming languages, applications. Safety and Economy of Robots: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robots.	14
III	**Automation:** Introduction, Types, Levels, Advantages, Limitations, Strategies, Future of Industrial Automation, Design Process, Product Life Cycle; Design For Manufacturing, And Concurrent Engineering; Product Design in Conventional And CIM Environment; Terms i.e.. CAD, CAE, CAM, CAP, CAPP, CATD, MRP And CAQ.	14
IV	**Group Technology:** Definition, Principle, Advantages, Limitations, Applications Of Group Technology, Cellular Manufacturing System, Part Family, Automated Guided Vehicle, Automated Storage And Retrieval System, Digital Manufacturing, Reverse Engineering.	14
V	**Modern Production Technology:** Introduction, Definition, Principle, Advantages, Limitations, Applications of Flexible Manufacturing System, Lean Productions and design for six-sigma, Agile Production, Artificial Intelligence, Intelligent Machine Tool, Smart Machines and Expert System For Manufacturing, Virtual Manufacturing, Green Manufacturing, Rapid Prototype.	14

Text Book/References Books/ Websites:

1. K. Shimon; Handbook of Industrial Robots; John Wiley & Sons.
2. R. K. Mittal, Nagrath; Robotics and Control; TMH
3. Bhupendra Gupta, Raji N.Mishra; Veerendra Kumar,Industrial Robotics, Dhanpat Rai, New Delhi
4. R.K. Jain, Production Technology, Khanna Publishers.

Suggested List of Laboratory Experiments: (Expandable):- Nil

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P	External (70)	Internal (30)	Total (100) Min: 40 (D Grade)	External (35)	Internal (15)	Total (50) Min: 20 (D Grade)
MET-1703	**Industrial Engineering and Operations Research**	3	1	1						

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks: 20	Assignment/Quiz/Attendance Max. Marks: 10
Practical Internal Max Marks: 15	Lab work & Sessional – Max Marks: 10	Assignment / Quiz/Attendance- Max. Marks: 05

Pre-Requisite	General study of management and safety management
Course Outcome	1. Ability to understand about industrial planning, process planning and material handling
	2. To understand about inventory control and job distribution.
	3. To understand about safety and its importance in industrial work

Unit	Contents (Theory)	Marks Weightage
I	**Industrial Engineering:** Definition, development, Object, Contribution & function of Industrial Engineering, Place of Industrial engineering in an organization, Management Ergonomics, Objectives and need for maintenance, Types of maintenance, Breakdown, Predictive and Preventive Maintenance, Condition based maintenance system. Equipment replacement policy: Reasons, Deterioration, Obsolescence, Depreciation, Methods for depreciation calculation. Value Engineering; Definition, Objectives & use of value analysis, Application & techniques.	**14**
II	**Work Study:** Introduction and definition of Work-study, Productivity and work study, Prerequisites of conducting a work study. **Method Study:** Introduction, definition, procedure, Recording techniques, Flow Process Charts, Critical examination by questioning technique, man-machine chart, Motion economy principles, Micro motion study –Therbligs. **Work Measurement:** Definition, Objectives, Techniques of Work measurement, Selection & timing the job, Rating, Allowances, Normal and standard time determination, Work sampling.	**14**
III	**Operations Research:** Introduction: Definition and Development of Operations Research, Necessity and scope of Industry, Decision making, OR models, application, Difficulties and Limitation of OR, Linear Programming Maximization and minimization of function with or without Constraints, Formulation of a linear programming problem, Graphical method and Simplex method, Big M method, Two phase method, Degeneracy, Application of Linear Programming in Mechanical Engineering.	**14**
IV	**The Transportation Problems:** Mathematical formulation, Stepping stone method, Modified Distribution Method, Vogel's Approximation Method, Solution of balanced and unbalanced transportation problems and case of Degeneracy. **Assignment Problems:** Mathematical formulation of assignment problems, Solution of assignment problems, Travelling salesman problems, Air crew Assignment problems.	**14**
V	**Network Analysis:** CPM/PERT, Network Representation, Techniques for drawing network, Resource smoothing and levelling, Project cost, Optimum project duration, Project crashing, Updating, Time estimation in PERT.	**14**

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Text Book/References Books/ Websites:

1. Martand Telsang; Industrial Engineering and Production Management; S Chand & Company
2. Philip E Hicks; Industrial Engineering & Management: A new perspective; Mcgraw Hill
3. N.J. Manek; Comprehensive Industrial Engineering; Laxmi Publication (P) Ltd.
4. S. Dalela, Mansoor Ali; Industrial Engineering and Management Systems; Standard Publishing
5. Hira & Gupta; Operation Research; S. Chand & Co.
6. O.P.Khanna; Industrial Engineering & management; Khanna Publication.

Suggested List of Laboratory Experiments: (Expandable):- Nil

1. To study the Peg board experiment.
2. Stop watch time study.
3. Performance rating exercise.
4. Graphic tools for method study.
5. Work sampling.
6. MTM practice.
7. Study of physical performance using tread mill and Ergo cycle.
8. Physical fitness testing of individuals.
9. Experiments using sound level and lux meters.
10. To solve different Problems by graphical and analytical methods contained in the syllabus. Different programming software may be used.

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	**T**	**P**	**External (70)**	**Internal (30)**	**Total (100)** Min: 40 (D Grade)	**External (35)**	**Internal (15)**	**Total (50)** Min: 20 (D Grade)
MET-1704	**Control System and Electrical Machines**	3	1	1						

Duration of Theory (Externals): 3 Hours

Theory Internal- Max Marks: 30	Best of Two Mid Semester Test – Max Marks: 20	Assignment/Quiz/Attendance- Max. Marks: 10
Practical Internal Max Marks: 15	Lab work & Sessional – Max Marks: 10	Assignment / Quiz/Attendance- Max. Marks: 05

Pre-Requisite	Basic knowledge of Electrical tools.	
Course Outcome	1.	Design various circuits using operational amplifiers.
	2.	Learn the measurement systems, errors of measurement,
	3.	Study the working principle of displacement transducers and their applications.

Unit	Contents (Theory)	Marks Weightage
I	**Systems:** Continuous/Discrete, Time-invariant/Time-varying, Linear/Nonlinear, Open loop/Closed loop, Effects of negative feedback, Transfer Functions – (example: R-L-C series circuit or equivalent), Order and type of transfer functions, Block diagram representation of systems (example: D.C. motor or equivalent), Block diagram algebra.	**14**
II	**Signal Flow Graph:** Time and frequency domain specifications, Transient Analysis of standard first and second order systems with unity feedback, Transient and steady state errors – definitions, Error constants.	**14**
III	**Stability:** Routh Hurwitz Criteria and Nyquist stability criterion, Relative stability: Siginificance of Gain margin and phase margin, Construction of Root locus, Bode plots and Polar plots, Minimum/Non-minimum phase systems, Transportation lag, Pade approximation.	**14**
IV	**Case Studies:** Effect of P, PI, PD and PID control, Effects of Lead and lag compensation time domain and frequency domain analysis, Effect of tacho-generator feedback.	**14**
V	**Control System Components:** Potentiometers, Synchros, Tachogenrators, A.C.and D.C. Servomotors, Gyroscope.	**14**

Text Book/References Books/ Websites:

1   M. Gopal, Control Systems Principles and Design, Second Edition, Tata McGraw Hill 2002.
2   Benjamin C. Kuo, Automatic Control Systems, 7th Edition, Prentice Hall of India, 1995.
3   Naresh K. Sinha, Control Systems, CBS college Publishing, 1986.

Suggested List of Laboratory Experiments (Expandable):- Nil

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P	External (Nil)	Internal (Nil)	Total	External (Nil)	Internal (50)	Total (50)
MET-1705	**Mechanical Measurements and Metrology Lab**	-	-	1			Nil			Min: 20 (D Grade)

Duration of Theory (Externals): Nil

Theory Internal- Max Marks: Nil	Best of Two Mid Semester Test – Max Marks: Nil	Assignment/Quiz/Attendance- Max. Marks: Nil
Practical Internal Max Marks: 50	Lab work & Sessional – Max Marks: Nil	Assignment / Quiz/Attendance- Max. Marks: 50

Pre-Requisite	
Course Outcome	1. To understand the basic measurement units and able to calibrate various measuring devices
	2. To express error and correction factors of various measuring devices
	3. To use measuring tools such as Sine Bar, Sine Center, Bevel Protractor, Tool Maker Microscope, Gear Tooth Micrometer, Optical Flats etc.

Unit	Contents (Theory)	Marks Weightage
I	**Mechanical measurements:** Mechanical Engineering: Basic experimental laboratory measurements, such as measurement of strain, pressure, force, position, and temperature. **Metrology:** Measurements using Optical Projector / Toolmaker Microscope, Measurement of angle using Sine Center / Sine bar / bevel protractor ,Measurement of alignment using Autocollimator / Roller set, Measurement of cutting tool forces using a) Lathe tool Dynamometer b) Drill tool Dynamometer, Measurement of Screw threads Parameters using Two wire or Three-wire method, Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator, Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer, Calibration of Micrometer using slip gauges and Measurement using Optical Flats	50

Text Book/References Books/ Websites:
1. I.C. Gupta; Engineering Metrology; Dhanpat Rai Publications, Delhi.
2. R.K. Jain; Mechanical Measurements; Khanna Publishers, 1994
3. D. Faulk Alsutko; Industrial Instrumentation Jerry; Cengage Asia Pvt. Ltd. 2002.
4. Ernest O. Doebelin; Measurement Systems Applications and Design 5th Ed; McGraw Hill Book Co.
5. Anand K. Bewoor & Vinay A. Kulkarni; Metrology & Measurement;Tata McGraw Hill Pvt. Ltd., New Delhi

Suggested List of Laboratory Experiments (Expandable):
1. Calibration of vernier caliper & measurement of the given component
2. Power measurement using Rope brake dynamometer
3. Study of Linear Measuring Instruments
4. Measurement of Taper Angle Using Slips, Rollers & Sine bar
5. Tool Makers Microscope
6. Gear Measurement
7. Thread Measurement 6 Measurement of Surface Finish
8. Machine Tool Alignment Tests
9. Profile Projector

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P	External (Nil)	Internal (Nil)	Total	External (105)	Internal (45)	Total (150)
MET-1706	**Minor Project**	-	-	3			Nil			Min: 60 (D Grade)

Duration of Theory (Externals): Nil

Theory Internal- Max Marks: Nil	Best of Two Mid Semester Test – Max Marks: Nil	Assignment/Quiz/Attendance Max. Marks: Nil
Practical Internal Max Marks: 45	Lab work & Sessional – Max Marks: 40	Assignment / Quiz/ Attendance Max. Marks: 05

Pre-Requisite	Fundamental Engineering concepts of concern discipline.
Course Outcome	Student should able to:
	1. Identify, analyze & define the problem.
	2. Generate alternative solutions to the problem identified.
	3. Compare & select feasible solutions from alternatives generated.
	4. Work effectively in a team.

Unit	Contents (Theory)	Marks Weightage
I	Students shall be encouraged to form groups (Maximum 5) to do a Minor Project on technical topic of concern branch. The student should prepare a working system or some design or understanding of a complex system (on minor level) that he has selected for his/her minor project work using system analysis tools and submit the same in the form of a write-up i.e. detail project report. The student should maintain proper documentation of different stages of project such as concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan wherever applicable. Each student is required to prepare a project report based on the above points and present the same at the final examination with a demonstration of their project.	150

Text Book/References Books/ Websites: Nil
Suggested List of Laboratory Experiments :- (Expandable): Nil

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	**T**	**P**	**External (Nil)**	**Internal (Nil)**	**Total**	**External (70)**	**Internal (30)**	**Total (100)**
MET-1707	**Industrial Training-II**	-	-	2			**Nil**			Min: 40 (D Grade)

Duration of Theory (Externals): Nil

Theory Internal- Max Marks: Nil	Best of Two Mid Semester Test – Max Marks: Nil	Assignment/Quiz/Attendance Max. Marks: Nil
Practical Internal Max Marks: 30	Lab work & Sessional – Max Marks: 25	Assignment / Quiz/ Attendance Max. Marks: 05

Pre-Requisite	Fundamental Engineering concepts of concern discipline.
Course Outcome	1. Enrich their practical learning and they will be better equipped to integrate the practical experiences with the classroom learning process. 2. Interact with real World of Work and should try to learn as much as possible from real life experiences by involving with industry staff.

Unit	Contents (Theory)	Marks Weightage
	The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. Industrial training of the students is essential to bridge the wide gap between the classroom and industrial environment. As a part of B. Tech. curriculum, MET1707, Industrial Training -II is a Practical course, which the students should undergo in reputed Private / Public Sector / Government organization / companies as industrial training of minimum two weeks to be undergone by the student in the semester break after VI semester theory examinations. **Training period**: Minimum of four weeks or 30 (Thirty) Days. **Evaluation:** Seventh semester **Companies / Areas covered**: Any field related to concern branch / discipline of Engineering. **Grading**: As per Scheme. **Note:** Presentation will take place the following week after you complete your training. The presentation is evaluation by your class in charge. Report must be submitted during power point presentation. The report evaluation is done by your class in charge. A Viva voce comprising comprehensive questions based on your presentation and training undergone. **Etiquette:** Dress properly, Behave well, Portray good image as a university student, Be punctual, Observe work ethics, Concern for safety, Be professional.	**100**

Text Book/References Books/ Websites: Nil
Suggested List of Laboratory Experiments :- (Expandable): Nil