PEOPLE'S UNIVERSITY, BHOPAL

(Applicable for Admitted from Academic Session 2019-20 onwards)

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

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P	External	Internal	Total (100)	External	Internal	Total
MET-18101	Work Study and Ergonomics	3	1	-	(70)	(30)	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. Ability to knowledge of Industrial techniques.
	2. Knowledge of various process of Optimization.

Unit	Content (Theory)	Marks Weightage
I	**Method study:** purpose of work study, its objectives, procedure and applications; method study definition and basic procedure, selection of job, various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts, string diagram, flow diagram, multiple activity chart, SIMO, cyclographs and chrono-cyclographs; critical examination, development, installation and maintenance of improved method; principles of motion economy and their application in work design; micro motion study, memo motion study and their use in methods study.	**14**
II	**Work measurement:** Introduction & definition, objectives and basic procedure of work measurement; application of work measurement in industries; time study: basic procedure, equipments needed, methods of measuring time, selection of jobs, breaking a job into elements; numbers of cycles to be timed; rating and methods of rating, allowances, calculation of standard time. **Work sampling:** Basic procedure, design of work sampling study conducting work sampling study and establishment of standard-time.	**14**
III	**Job evaluation and incentive schemes:** Starlight line, Tailor, Merrick and Gantt incentive plans **Standard data system;** elemental and non-elemental predetermined motion systems, work factors system; Methods Time Measurement (MTM), MOST	**14**
IV	**Human factor engineering:** Definition and history of development of human factors engineering, types & characteristics of man-machine-system, relative capabilities of human being and machines; development and use of human factor data; information input and processing; Introduction to information theory; factors effecting information reception and processing; coding and selecting of sensory inputs.	**14**
V	**Display systems and anthropometric data:** Display- types of visual display, visual indicators and warning signals; factorial and graphic display; general principles of auditory and tactual display, characteristics and selection.	**14**

Text Book/References Books/ Websites:

1. ILO; work-study; International Labour Organization
2. MI Khan; Industrial Ergonomics; PHI Learning
3. RM Barrnes; Motion and Time Study; Wiley pub
4. ED Megaw; Contenmprory ergonomics; Taylor & fracis
5. Sandera M and McCormick E; Human Factors in Engg and design; MGHill

Suggested List of Laboratory Experiments (Expandable):- Nil

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

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total (100)	External	Internal	Total
MET-18102	Fracture Mechanism & Failure Analysis	3	1	-	External (70)	Internal (30)	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. Know types of concepts of fatigue failure.
	2. Understand the different modes of crack displacement
	3. Understand the fretting of surfaces in contact and effect of under stresses and overstress.

Unit	Content (Theory)	Marks Weightage
I	**Fatigue :-** (Normal conditions) Concepts of fatigue failure, statistical methods. Endurance limit, S.N.diagram, stress cycling, strain cycling, Goodman and Gerber relations, and their application to design problems. Review of stress concentration.(Controlling factors)- Effect of frequency of the cyclic stress, effect of temperature, size, form, surface condition, surface protection, residual stresses environment(corrosion fatigue), fretting of surfaces in contact and effect of under stresses and overstress.	**14**
II	**Fatigue Testing Machines:** specimen and test procedures. Appearance of fatigue fractures: Surface fatigue, contact stresses. Brief introduction to Random load fatigue.	**14**
III	**Creep: Mechanisms** of creep, Transient creep, viscous creep. Creep fractures, Analysis of creep curves, stress relaxation, creep tests.	**14**
IV	**Fracture:** Historical background, modes of crack displacement, opening mode, sliding mode, tearing node; Stress intensity factor of a crack, stress intensity factor in finite bodies; Fracture criterion- Griffith's fracture stress, Fatigue toughness (Critical stress intensity factor). Fracture crack propagation, plastic deformation around crack tip, crack opening is placement. Application to design of steam turbine rotor discs. Thin walled pressure vessels and thin and parallel pressure piping's.	**14**
V	**Fatigue :-** (Normal conditions) Concepts of fatigue failure, statistical methods. Endurance limit, S.N.diagram, stress cycling, strain cycling, Goodman and Gerber relations, and their application to design problems. Review of stress concentration.(Controlling factors)- Effect of frequency of the cyclic stress, effect of temperature, size, form, surface condition, surface protection, residual stresses environment(corrosion fatigue), fretting of surfaces in contact and effect of under stresses and overstress.	**14**

Text Book/References Books/ Websites:

1. Strength and Resistance of Metals -Lessels-J& W
2. Engg. Material Science-Richards -Prentice Hall. Elementary Engg
3. Fracture Mechanics- David Brock- Nordhoff
4. Advanced Machine Design- A.Mubeen-Khanna

Suggested List of Laboratory Experiments (Expandable):- Nil

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

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total (100)	External	Internal	Total
MET-18103	Mechatronics	3	1	-	External (70)	Internal (30)	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. Ability to understand the Knowledge of Mechatronics, need and applications.
	2. Understand the importance of sensors in Mechatronics.
	3. Understand the role of interfacing of different hard wares in industry.

Unit	Content (Theory)	Marks Weightage
I	**Introduction:** Introduction to Mechatronics, need and applications, elements of Mechatronics systems, role of Mechatronics in automation, manufacturing and product development.	**14**
II	**Sensors and Feedback Devices:** Importance of sensors in Mechatronics, Static and Dynamic characteristics of sensors, errors and output impedance of sensors, transducers for measurement of displacement, strain, position, velocity, noise, flow, pressure, temperature, humidity, vibration, liquid level, vision sensors.	**14**
III	**Control Elements and Actuators:** On/off push buttons, control relays, thermal over load relays, contactors, selector switches, solid state switches. Mechanical actuators – types of motion, gear trains, belt and chain drives, screw rods. Electrical actuators, solenoids, DC drives and AC variable frequency drives, AC and DC motors, servomotors, stepper motors, linear motors. Hydraulic and Pneumatic controls, functional diagram - control valves, cylinders and hydro motors.	**14**
IV	**Computational Elements and Controllers:** Basic concepts of control systems – open loop, closed loop, semi closed loop control system, block and functional diagrams controllers for robotics and CNC, linear and rotary encoders, timers, counters, microprocessors and microcontrollers: introduction, programming and applications, introduction to PLC, simple programs for process control application based on relay ladder logic-Supervisory Control and Data Acquisition Systems (SCADA) and Human Machine Interface (HMI).	**14**
V	**Interfacing Systems:** Introduction to interfacing of different hard wares in industry, need for networks in industrial plants, hierarchy and structure of networking, RS 232 based network, Ethernet, TCP/IP, MAP/TOP; **Application of Mechatronics Systems:** Introduction to factory automation and integration, design of simple Mechatronics systems, Case studies based on the application of Mechatronics in manufacturing, autotronics, bionics and avionics.	**14**

Text Book/References Books/ Websites:

1. W. Bolton, Mechatronics, Pearson publications (ISBN 978- 81-3176253-3)
2. Devdas Shett, Richard A. Kolk, Mechatronics System Design, Brooks/Cole, Thomson learning
3. John Watton, Fundamentals of Fluid power and control, Cambridge university press Andrejz M.Pawlak, Sensor and Actuators in Mechatronics Design, Taylor and Francis

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-1802	Machine Design-II	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	Basic Knowledge of Drawing.
Course Outcome	1. Student should be able to Use IS convention of representing various machine components
	2. Interpret drawings and the assembly of a given set of details of machine components.
	3. Know the significance & use of tolerances of size, forms & positions.

Unit	Content (Theory)	Marks Weightage
I	**Design Philosophy:** Problem identification- problem statement, specifications, constraints, Economic & financial feasibility, societal & environmental feasibility, Selection of Fits and tolerances ,Selection of Materials, Ergonomics and value engineering considerations in design, Role of processing in design, Design considerations for casting and machining.	**14**
II	**Belts:** Selection of belt, Condition for Transmission of max, Design of belt drives, Flat & V-belt drives,. Power, , design of rope drives, design of chain drives, Numerical.	**14**
III	**Gears:** Force analysis of gear tooth, modes of failure, beam strength, Lewis equation, form factor, formative gear and virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear; Design of straight tooth spur and Helical Gears. Bevel Gears**:** Application of bevel, formative gear and virtual number of teeth; Force analysis; Lewis equation for bevel gears; Strength against wear; Design of bevel gear. Numerical.	**14**
IV	**Design of I.C. Engine Components:** General design considerations in I C engines; design of cylinder; design of piston and piston-rings; design of connecting rod; design of crankshaft. Numerical.	**14**
V	**Optimization**: Basic concept of optimization, classification of optimization, optimization techniques, engineering applications of optimization. **Classical optimization techniques**: Constrained-unconstrained optimization, single-variable optimization, multivariable optimization, solution by direct search method, solution by Lagrange-multipliers method. Numerical.	**14**

Text Book/References Books/ Websites:

1. J.E. Shigly ; Machine Design; McGraw Hill Publications
2. V.B. Bhandari; Design of Machine Elements; TMH Publications
3. P.C.Sharma & D.K. Agrawal; Machine Design; Kataria & Sons Publications
4. R. Phelan; Principles of Mechanical Design; McGraw Hill Pub
5. M. F. Spott; Machine Design; PHI

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

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

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total (100)			Total (50)
MET-1803	Energy Sources and Audit	3	1	1	External (70)	Internal (30)	Min: 40 (D Grade)	External (35)	Internal (15)	Min: 20 (D Grade)

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	Nil
Course Outcome	1. Ability to understand different Energy Sources.
	2. To understand different types of Ecosystem.
	3. To understand about Biodiversity and its Conservation.

Unit	Contents (Theory)	Marks Weightage
I	**Energy resources**: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.The multidisciplinary nature of environmental studies Definition, scope and importance , Need for public awareness	**14**
II	**Ecosystems** · Concept of an ecosystem · Structure and function of an ecosystem · Producers, consumers and decomposers · Energy flow in the Ecosystem · Ecological succession · Food chains, food webs and ecological pyramids · Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest Ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)	**14**
III	**Biodiversity and its Conservation** - Introduction – Definition: genetic, species and ecosystem diversity · Biogeographically classification of India · Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values · Biodiversity at global, national and local levels · India as a mega-diversity nation · Hot-spots of biodiversity · Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts · In-situ and Ex-situ conservation of biodiversity	**14**
IV	**Environmental Pollution Definition** · Causes, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear pollution ·Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. **Disaster management**: floods, earthquake, cyclone and landslides.	**14**
V	**Human Population and the Environment** · Population growth, variation among nations · **Population explosion** – Family Welfare Programmes, Environment and human health · Human Rights · Value Education · HIV / AIDS · Women and Child Welfare · Role of Information. **Technical Field Work** · Visit to a local area to document environmental assets river/forest/grassland/hill/mountain · Visit to a local polluted site – Urban / Rural / Industrial / Agricultural · Study of common plants, insects, birds · Study of simple ecosystems-pond, river, hill slopes, Environment and Human Health ·	**14**

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

Text Book/References Books/ Websites:

1. Kothari, Singal & Rajan; Renewable Energy Sources and Emerging Technologies, PHI Learn.
2. B.H. Khan: Non Conventional Energy Source-Tata Mc Graw-Hill, New Delhi.
3. J.W. Twidell & A.D. Weir: Renewable Energy Sources- The University Press.
4. S.P. Sukhatme: Solar Energy – Tata Mc Graw-Hill, New Delhi.
5. H.P. Grag & J. Prakash: Solar Energy Fundamental and Applications – Tata Mc Graw-Hill.
6. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, Narosa Publication.

Suggested List of Laboratory Experiments :- (Expandable):

1. Studying the various energy conservation methods useful in power generation, transmission and distribution.
2. To study of Sun Radiation with the help of Pyrometer.
3. Determine depreciation cost of a given energy conservation project/equipment.
4. Study of various measuring instruments used for energy audit : Lux meter, Power analyzer, flue gas analyzer.
5. Identifying the energy conservation opportunities in a lab, department or institute.
6. Prepare a sample energy audit questionnaire.
7. Prepare a sample energy audit report.

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total (100)			Total (50)
MET-1804	Quality Control and Reliability	3	1	1	External (70)	Internal (30)	Min: 40 (D Grade)	External (35)	Internal (15)	Min: 20 (D Grade)

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	Nil
Course Outcome	1. Ability to understand the Industrial tools and techniques.
	2. Ability to understand the sampling process.
	3. To know about the function of quality and Reliability.

Unit	Contents (Theory)	Marks Weightage
I	**Introduction and Process Control for Variables:** Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors - process capability - process capability studies and simple problems -Theory of control chart- uses of control chart-Control chart for variables - X chart, R chart and s chart. Six sigma concept. TPM, TQM, JIT, Kaizen.	**14**
II	**Process Control for Attributes:** Control chart for attributes -control chart for proportion or fraction defectives - p chart and np chart - control chart for defects - C and U charts, State of control and process out of control identification in charts.	**14**
III	**Acceptance Sampling:** Lot by lot sampling - types - probability of acceptance in single, double, multiple sampling techniques-O.C. curves - producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans	**14**
IV	**Life Testing - Reliability:** Life testing - Objective - failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration - simple problems. Maintainability and availability- simple problems. Acceptance sampling based on reliability test - O.C Curves.	**14**
V	**Reliability:** Reliability improvements-techniques- use of Pareto analysis - design for reliability - redundancy unit and standby redundancy - Optimization in reliability - Product design - Product analysis - Product development - Product life cycles.	**14**

Text Book/References Books/ Websites:

1. Juran and Gryna; Quality Planning and Analysis,TMH.
2. M.Younus et al, Quality Control & Reliability; PHI Learning.
3. L Sugandhi and A Samual; Total Quality Management; PHI Learning.
4. Naidu Babu and Rajendran; TQM; New age International publication.
5. B Jankiraman and RK Gopal; Total Quality Management- Text and Cases; PHI Learning

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Suggested List of Laboratory Experiments (Expandable):-

1 To Study the Process Control Chart.
2 To Study the Six Sigma Concept.
3 To Study the control charts for Attributes.
4 To Study the concept of Standard Sampling Plan.
5 To Study Operating Characteristics (OC) Curves.
6 To Study Life Testing Reliability.
7 To Study Product Life Cycle.
8 Case study.

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Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total (100)			Total (50)
MET-1805	Engineering Software Lab-III	-	-	1	External (Nil)	Internal (Nil)	Min: 40 (D Grade)	External (Nil)	Internal (50)	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	Basic knowledge of Software.
Course Outcome	1. Ability to draw the various components using software.
	2. Abililty to understand the knowledge of fluid mechanics using software.
	3. Study the various machines parts and its applications.

Unit	Contents (Theory)	Marks Weightage
I	**Solid Modeling Software:** In this lab student will get an opportunity to learn any one solid modeling software from Autodesk Inventor, Pro/ENGINEER, CATIA, SOLID EDGE, SOLID WORKS, UNIGRAPHICS etc as assigned by the faculty. Students will be required to learn the methods related to Sketching, part modeling, assembly, wireframe / surfacing modeling & Drafting of various mechanical components.	**50**

Text Book/References Books/ Websites:

http://www.colorado.edu/MCEN/programs/undergraduate/matlab_tutorials/

Suggested List of Laboratory Experiments (Expandable):-

Programs to be performed based on the topics contained in the syllabus.

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

Subject Code	Subject Title	Credit			Theory			Practical		
		L	T	P			Total			Total (200)
MET-1806	Major Project	-	-	4	External (Nil)	Internal (Nil)	Nil	External (140)	Internal (60)	Min: 80 (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: 60	Lab work & Sessional – Max Marks: 55	Assignment / Quiz/Attendance Max. Marks: 05

Pre-Requisite	Nil
Course Outcome	The student will be able to-Utilize technical resources:
	1. Identify, analyze & define the problem.
	2. Generate alternative solutions to the problem identified.
	3. Compare & select feasible solutions from alternatives generated.
	4. Design, develop, manufacture & operate equipment/program.
	5. Acquire higher-level technical knowledge by studying recent development in Engineering field.
	6. Compare machines/devices/apparatus for performance practices.
	7. 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 that he has selected for his 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 need analysis, market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan wherever applicable. Each group of students is required to prepare a project report based on the above points and present the same at the final examination with a demonstration of the working system. Evaluation will be based on his performance in technical work pertaining to the solution of a small size problem, project report, and presentation of work and defending it in a viva-voce.	**200**

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	Internal	Total	External	Internal	Total (50)
BT-1807	Professional Ethics and Proficiency	-	-	1	(Nil)	(Nil)	Nil	(35)	(15)	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: 15	Lab work & Sessional – Max Marks: 10	Assignment / Quiz Max. Marks: 05

Pre-Requisite	General study of thermal Engineering.
Course Outcome	1. To provide basic familiarity about Engineers as responsible Experimenters, Research.
	2. The students will understand various social issues, industrial standards, **code of ethics** and role of **professional ethics** in engineering field .

Unit	Contents (Theory)	Marks Weightage
I	Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.	**14**
II	Communication and personality development covering, Psychological aspects of communication, cognition as a part of communication; Emotional Intelligence; Politeness and Etiquette in communication; Cultural factors that influence communication; Mannerisms to be avoided in communication; Language and persuasion; Language and conflict resolution;	**14**
III	Career Oriental Communication covering, Resume and Bio-data: Design & style; Applying for a job: Language and format of job application. Job Interviews: purpose and process;	**14**
IV	Advanced Techniques in Technical Communication covering, Interview through telephone/video-conferencing;	**14**
V	Power-point presentation: structure and format; Using e-mail for business communication; Standard e-mail practices; Language in e-mail; Using internet for collecting information; Referencing while using internet materials for project reports.	**14**

Text Book/References Books/ Websites:Nil

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