UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Automobile Engineering

Second Year with Effect from AY 2017-18
Third Year with Effect from AY 2018-19
Final Year with Effect from AY 2019-20

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Chairman's Preamble:

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Mechanical Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brain storming sessions, which was attended by more than 40 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the undergraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems
3. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process
4. To prepare the Learner for a successful career in Indian and Multinational Organisations

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

Dr. S. M. Khot

Chairman, Board of Studies in Mechanical Engineering, University of Mumbai

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
AEC501	Internal Combustion Engines*	04	--	04	--	04
AEC502	Mechanical Measurements and Control*	04	--	04	--	04
AEC503	Heat Transfer*	04	--	04	--	04
AEC504	Automotive Systems	03	--	03	--	03
AEDLO 501X	Department Level Optional Course I	04	--	04	--	04
AEL501	Internal Combustion Engines*	--	02	--	01	01
AEL502	Mechanical Measurements and Control*	--	02	--	01	01
AEL503	Heat Transfer*	--	02	--	01	01
AEL504	Automotive Systems	--	02	--	01	01
AEL505	Manufacturing Sciences Lab*	--	02	--	01	01
AEL506	Business Communication and Ethics*	--	$2^{\$}+2$	--	02	02
Total		**19**	**14**	**19**	**07**	**26**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
AEC501	Internal Combustion Engines*	20	20	20	80	03	--	--	100
AEC502	Mechanical Measurements and Control*	20	20	20	80	03	--	--	100
AEC503	Heat Transfer*	20	20	20	80	03	--	--	100
AEC504	Automotive Systems	20	20	20	80	03	--	--	100
AEDLO 501X	Department Level Optional Course I*	20	20	20	80	03	--	--	100
AEL501	Internal Combustion Engines*	--	--	--	--	--	25	25	50
AEL502	Mechanical Measurements and Control*	--	--	--	--	--	25	25	50
AEL503	Heat Transfer*	--	--	--	--	--	25	25	50
AEL504	Automotive Systems	--	--	--	--	--	25	25	50
AEL505	Manufacturing Sciences Lab*	--	--	--	--	--	25	--	25
AEL506	Business Communication and Ethics*	--	--	--	--	--	50	--	50
Total				**100**	**400**		**175**	**100**	**775**

Course Code	Department Level Elective Course I
AEDLO5011	Press Tool Design*
AEDLO5012	Machining Sciences and Tool Design*
AEDLO5013	Design of Jigs and Fixtures*

***Common with Mechanical Engineering**

$ Theory for entire class to be conducted

Course Code	Course Name	Credits
AEC501	Internal Combustion Engines*	4

Objectives

1. To familiarize with the working of S.I. and C.I. engines and its important systems
2. To acquaint with the various methods for measurement of engine performance
3. To provide insight into the harmful effects of engine pollutants and its control
4. To familiarise with the latest technological developments in engine technology

Outcomes: Learner will be able to…

1. Demonstrate the working of different systems and processes of S.I. engines
2. Demonstrate the working of different systems and processes of C.I. engines
3. Illustrate the working of lubrication, cooling and supercharging systems.
4. Analyse engine performance
5. Illustrate emission norms and emission control
6. Comprehend the different technological advances in engines and alternate fuels

Module	Detailed Contents	Hrs.
01	**Introduction** Classification of I.C. Engines; Parts of I.C. Engine and their materials, Cycle of operation in Four stroke and Two-stroke IC engines and their comparative study; Fuel air cycles and their analysis, Actual working cycle, Valve Timing Diagram. LHR Engines, Homogeneous charge compression Ignition,Rotary engine-Six stroke engine concept	06
02	**S.I. Engines** **Fuel Supply System:** Spark ignition Engine mixture requirements, Fuel-Air ratio, Simple carburettor and auxiliary circuits (excluding mathematical analysis of carburettors) Injection systems: Single-point and Multipoint injection, Gasoline Direct Injection **Ignition System:** Battery Ignition System, Magneto Ignition System, Functions and working of ignition coil, spark plug, contact breaker point, Requirements and working of Ignition advance mechanisms; mechanical and vacuum, Electronic Ignition Systems; Capacitor Discharge Ignition System, Transistorized Coil Assisted Ignition System, Transistor Ignition system with contactless breaker **Combustion :** Combustion phenomenon in SI Engines, Ignition delay, Flame propagation, Pressure-Crank angle diagram, Abnormal combustion, Auto ignition, Detonation and Knocking, Factors affecting combustion and detonation, Types of combustion chambers	12
03	**Compression Ignition Engines** **Fuel Injection Systems:** Air injection systems, Airless/solid injection systems, Common rail, individual pump, distributor and unit systems. Injection pumps, Fuel injector, Types of nozzle, Electronically controlled unit fuel injection system **Combustion:** Combustion phenomenon in C I engines, Stages of combustion, Delay period, Knocking, Pressure-Crank angle diagram, Factors affecting combustion and knocking, Types of combustion chambers	10
04	**Engine lubrication:** Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems **Engine Cooling:** Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling **Supercharging/Turbo-charging:** Objectives, Limitations, Methods and Types,Different arrangements of turbochargers and superchargers	06

05	**Engine Testing and Performance** Measurement of Brake Power, Indicated Power, Frictional Power, Fuel Consumption, Air flow, BMEP, Performance characteristic of SI and CI Engine Effect of load and speed on Mechanical, Indicated Thermal, Brake Thermal and Volumetric efficiencies, Heat balance sheet. **Engine Exhaust Emission and its control** Constituents of exhaust emission at its harmful effect on environment and human health, Formation of NOx, HC, CO and particulate emissions, Methods of controlling emissions; Catalytic convertors, particulate traps, Exhaust Gas Recirculation, EURO and BHARAT norms.	10
06	**Alternative Fuels** Alcohol - Hydrogen - Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas - Producer Gas - Properties - Suitability - Engine Modifications - Merits and Demerits as fuels. **Basics of Electronic Engine Controls:** Electronic Control module (ECM), Inputs required and output signals from ECM, Sensors: Throttle Position, Inlet Air Temperature, Coolant Temperature, Crankshaft Position, Camshaft Position, Mass Air flow and Exhaust Gas Oxygen sensors, their construction and importance in ECM. Electronic Spark control, Air Management system, Idle speed control	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of content and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the syllabus.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the syllabus**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Internal Combustion Engines, Willard W.Pulkrabek, Pearson Education.
2. Internal Combustion Engines, Shyam Agrawal, New Age International
3. Internal Combustion Engine, Mathur and Sharma
4. Internal Combustion Engines, Mohanty, Standard Book House
5. Internal Combustion Engine, Gills and Smith
6. Internal Combustion Engines Fundamentals, John B. Heywood , TMH
7. Internal Combustion Engines, Gupta H N, 2nd ed, PHI
8. Internal Combustion Engine, V Ganesan, TMH
9. Introduction to Internal Combustion Engines, Richard Stone, Palgrave Publication, 4th Edition
10. Internal Combustion Engine, S.L. Beohar
11. Internal Combustion Engine, P.M Heldt.
12. Internal Combustion Engines, V.L. Maleeve
13. Internal Combustion Engine, E.F. Oberi.
14. Internal Combustion Engine, Domkundwar

Course Code	Course Name	Credits
AEC502	Mechanical Measurement and Control*	4

Objectives

1. To impart knowledge of architecture of the measurement system
2. To deliver working principle of mechanical measurement system
3. To study concept of mathematical modelling of the control system
4. To acquaint with control system under different time domain

Outcomes: Learner will be able to…

1. Classify various types of static characteristics and types of errors occurring in the system.
2. Classify and select proper measuring instrument for linear and angular displacement
3. Classify and select proper measuring instrument for pressure and temperature measurement
4. Design mathematical model of system/process for standard input responses
5. Analyse error and differentiate various types of control systems and time domain specifications
6. Analyse the problems associated with stability

Module	Contents	Hours
01	1.1 Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs. 1.2 Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. 1.3 Errors in measurement: Types of errors, Effect of component errors, Probable errors.	08
02	2.1 **Displacement Measurement**: Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder) , Nozzle Flapper Transducer 2.2 **Strain Measurement**: Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors 2.3 **Measurement of Angular Velocity**: Tachometers, Tachogenerators, Digital tachometers and Stroboscopic Methods. 2.4 **Acceleration Measurement:** theory of accelerometer and vibrometers, practical accelerometers, strain gauge based and piezoelectric accelerometers	08
03	**3.1 Pressure Measurement:** Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, High Pressure Measurements, Bridge man gauge. Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges **3.2 Flow Measurement**: Bernoulli flowmeters, Ultrasonic Flowmeter, Magnetic flow meter, rotameter **3.3 Temperature Measurement**: Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples, Pyrometers **3.4 Sensitivity analysis of sensor**-influence of component variation **3.5 Signal conditioning**: Amplifier, Conversion, Filtering, Impedance Buffering, Modulation / Demodulation, Linearization, Grounding and Isolation	08
04	**4.1** Introduction to control systems, Classification of control system. Open loop and closed loop systems. **4.2** Mathematical modelling of control systems, concept of transfer function, Block diagram algebra	06

05	**5.1 Transient and steady state analysis of first and second order system.** Time Domain specifications. Step response of second order system. Steady-state error, error coefficients, steady state analysis of different type of systems using step, ramp and parabolic inputs	**06**
06	**Stability analysis** 6.1 Introduction to concepts of stability, The Routh criteria for stability 6.2 Experimental determination of frequency response, Stability analysis using Root locus, Bode plot and Nyquist Plots 6.3 State space modeling 6.4 Process control systems, ON-OFF control. P-I-D Control	**12**

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of content and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the syllabus.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the syllabus**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References

1. Measurement Systems: Applications and Design, by EO Doebelin,5th Edition,*McGraw Hill*
2. Mechanical Engineering Measurements, A K Sawhney, *Dhanpat Rai& Sons, New Delhi*
3. Instrumentation & Mechanical Measurements, A KThayal
4. Control System Engineering by NagrathIJ and Gopal M, *Wiley EasternLtd.*
5. Modem Control engineering: by KOgata, *Prentice Hall*
6. Control systems by DhaneshManik, Cengage Learning
7. Engineering Metrology and Measurementsby N V Raghavendra and L Krishnamurthy, Oxford University Press
8. Instrumentation and Control System, W. Bolton, Elsevier
9. Experimental Methods for Engineers by J P Holman, McGraw Hills Int. Edition
10. Engineering Experimentation by EO Doebelin, McGraw Hills Int. Edition
11. Mechanical Measurements by S P Venkateshan, Ane books, India

Course Code	Course Name	Credits
AEC 503	Heat Transfer*	04

Objectives

1. To Study basic heat transfer concepts applicable for steady state and transient conditions
2. To Study mathematical modelling and designing concepts of heat exchangers

Outcomes: Learner will be able to…

1. Identify the three modes of heat transfer (conduction, convection and radiation).
2. Illustrate basic modes of heat transfer
3. Develop mathematical model for each mode of heat transfer
4. Develop mathematical model for transient heat transfer
5. Demonstrate and explain mechanism of boiling and condensation
6. Analyse different heat exchangers and quantify their performance

Module	Detailed Contents	Hrs.
01	**Basic concepts of heat transfer:**Define heat transfer and its importance in engineering applications, Difference between heat transfer and Thermodynamics, Physical Mechanism of modes of heat transfer, Governing laws of heat transfer, Conduction mode: Thermal conductivity, Thermal diffusivity, Convection mode: Free and Forced convection, Heat transfer Coefficient, Radiation mode: Emissivity, transmissivity, reflectivity, absorptivity, Black body, Grey body, Opaque body, Steady and unsteady heat transfer, One dimensional, two dimensional and three dimensional heat transfer, Thermal resistance concept in heat transfer, Thermal contact resistance	04
02	**Conduction:**Assumptions in heat conduction, Generalized heat conduction equation in rectangular, cylindrical coordinates, Initial and boundary conditions, Steady state heat conduction through plane wall, Composite wall, cylinder, composite cylinder wall, sphere, Internal Heat generation concept, Heat conduction with heat generation in plane wall, solid cylinder and solid sphere, Critical radius of insulation in cylinder and sphere	08
03	**Heat transfer from Extended Surface:**Types of extended surface and its significance, Governing differential equation for fin and its solution, Fin performance: Fin effectiveness and Fin efficiency, Thermo Well **Unsteady state heat transfer:**Applications of unsteady state heat transfer, Lumped system Analysis, Criteria for lumped system analysis: characteristic length, Biot Number, Thermal time constant and Response of a thermocouple, Heisler Charts **Numerical methods in heat transfer:**Significance of numerical methods in heat transfer, Finite difference formulation of differential equations, One-dimensional heat conduction.	08
04	**Convection:**Determination of heat transfer coefficient, Dimensional Analysis, Dimensionless numbers in free and forced convection and their significance **External Flow:**Velocity Boundary layer and Thermal Boundary layer, Laminar and turbulent flow over a flat plate, Flow across cylinder and sphere, Flow across bank of tubes **Internal Flow:**Velocity Boundary layer and Thermal Boundary layer, Laminar and Turbulent flow in tubes, General thermal analysis: Constant heat flux and constant surface temperature	10
05	**Radiation:**Basic laws of radiation, Black body radiation, Planck's law, Kirchhoff's law, Wein displacement law, Lambert cosine law, Radiation intensity, Radiation heat exchange between black bodies, Shape factor algebra, Radiation heat exchange between nonblack bodies, Electrical network approach for radiation heat exchange: Radiosity and irradiation, Radiation shield	08
06	**Boiling and Condensation:**Boiling heat transfer, Pool boiling: different regimes and pool boiling curve, Flow boiling: Different Regimes and Boiling curve, Condensation heat transfer, Film condensation, Dropwise Condensation **Heat Exchangers:**Types of heat exchangers, Overall heat transfer coefficient, Fouling factor, Analysis of heat exchangers, LMTD, Effectiveness –NTU method, Correction factor, Effectiveness of heat exchangers **Heat Pipe:** Introduction and application	10

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of content and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the syllabus.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the syllabus**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

ReferenceBooks:

1. Introduction to thermodynamics and Heat transfer by Yunus A Cengel2nd Edition, McGraw Hill International
2. Fundamentals of Heat and Mass Transfer by FPIncropera and D P deWitt, Wiley India
3. Heat Transfer by P S Ghoshdastidar, 2nd Edition, Oxford University Press
4. Heat and Mass Transfer, by R Rudramoorthy and LMalaysamy,2nd Edition, PEARSON
5. Heat Transfer by J P Holman, Mcgraw Hill
6. Heat Transfer by S P Sukhatme, University Press
7. Heat and Mass Transfer by PK Nag, TMH
8. Heat and Mass Transfer by Mahesh Rathod, Laxmi Publications
9. Heat and Mass Transfer byR K Rajput, S Chand and company

Course Code	Course Name	Credits
AEC 504	Automotive Systems	3

Objectives

1. To study basic and advance automotive systems.
2. To study working of different automotive systems and subsystems.
3. To study different vehicle layouts.
4. To have basic idea about how automotive systems are developed.

Outcomes: Learner will be able to…

1. Identify different automotive systems and subsystems.
2. Identify different automotive components.
3. Illustrate working and functions of various automotive components
4. Illustrate working and function of electric drive lines.
5. Comprehend working of Special vehicles through case study.
6. Identify and Demonstrate different vehicle layouts.

Module	Detailed Contents	Hrs.
01	**1. CLUTCHES** 1.1 Function requirements of Flywheel and clutch 1.2 Types of Single plate clutch 1.4 Clutch control systems 1.5 Clutch center plate construction 1.6 Direct release clutch 1.7 Centrifugally operated clutches 1.8 Multi-plate clutches 1.9 Angle spring clutch 1.10 Wet clutch 1.11 Fluid Coupling	08
02	**2.TRANSMISSION** 2.1 Purpose and Necessity of gear box 2.2 Constant mesh gear box 2.3 Sliding mesh gear box 2.4 Synchromesh gear box 2.5 Gear selector mechanism 2.6 Heavy vehicle gear boxes **2.7 Torque convertors** **2.8 Epicyclic gear box operation** **2.9 Semi – Automatic and Automatic transmission** 2.9.1 Hydraulic control systems 2.9.2 Electro hydraulic control systems 2.9.3 Automatic lay shaft gear boxes 2.9.4 Dual mode transmission with sequential gear change 2.9.5 Direct shift gear boxes 2.9.6 Over drive gears 2.9.7 Continuously variable transmissions **2.10 Electric drives** 2.10.1 General arrangement and description of electric transmissions 2.10.2 Working principle and control 2.10.3 Advantages and limitations of electric drives	08

03	**3. DRIVE LINES** 3.1 Drive Lines 3.1.1 Universal joints 3.1.2 Constant velocity joints 3.1.3 Propeller shaft construction 3.1.4 Drive line arrangement 3.1.5 Rear-wheel drive and front-wheel drive layouts 3.1.6 Front-wheel drive shafts 3.1.7 Tandem axle drive for heavy vehicles 3.1.8 Drive lines for public service vehicles	04
04	**4. FINAL DRIVE AND REAR AXLES** 4.1 Final drive gears and bearings 4.2 Differential gears 4.3 Differential- All types 4.4 Rear axle construction 4.5 Heavy vehicle rear axle 4.6 Four wheel drive systems 4.6.1 Basic consideration of four wheel drive 4.6.2 Part time four wheel drive 4.6.3 Full time four wheel drive	04
05	**5. BRAKING AND SUSPENSION SYSTEMS** 5.1 Braking System 5.1.1 Requirement and Types-Block Brakes, Band Brakes, Hydraulic brake, Air Brake, Endurance Brake 5.2 Suspension System 5.2.1 Basic ride considerations 5.2.2 Types of suspension systems 5.2.3 Types of suspension spring 5.2.4 Tandem axle suspension 5.2.5 Shock dampers 5.2.6 Adaptive suspension systems 5.2.7 Active roll control systems	06
06	**6. STEERING , TYRES, ROAD WHEELS AND HUBS** 6.1 Steering systems 6.1.1 Steering principles and layout 6.1.2 Front end geometry and wheel alignment 6.1.3 Steering and suspension ball joints 6.1.4 Manual steering gears 6.1.5 Steering axles for heavy vehicles 6.1.6 Hydraulic power-assisted steering 6.1.7 Speed-sensitive hydraulic power-assisted steering 6.1.8 Electro-hydraulic power-assisted steering 6.1.9 Electrical power-assisted steering 6.1.10 Types of four-wheel steering 6.2 Tires, Road wheels and Hubs 6.2.1 Introduction to Tire characteristics 6.2.2 Tire construction 6.2.3 Road wheels and hubs	06

Theory Examinations:

Internal Assessment for 20 marks:
Consisting **two compulsory class tests**
First test based on initial 40% of the content and second test based on remaining content (but excluding contents covered in Test I).

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the syllabus.

i) Question paper will comprise of total six questions.
ii) All questions carry equal marks.
iii) Questions will be mixed in nature (for example Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
iv) Only four questions need to be solved.

ReferenceBooks:

1. Light and Heavy Vehicle Technology, M.J. Nunney, Elsevier, Fourth Edition.
2. Automotive Technology, Jack Erjavec, Cengage Learning, Fifth Edition.
3. Automotive Braking, Thomas W. Birch, Cengage Learning, Third Edition.
4. Motor Automotive technology, Anthony E. Schwaller, Delmar, Third Edition.
5. Automotive suspension and steering systems, Thomas W. Birch, Delmar Cengage Learning, Third Edition.

Course Code	Course Name	Credits
AEDLO5011	Press Tool Design*	4

Objectives:

1. To acquaint with various press working operations for mass production of sheet metal components
2. To familiarise with sheet metal working techniques for design of press tools
3. To inculcate knowledge about scrap minimization, safety aspects and automation in press working

Outcomes: Learner will be able to….

1. Demonstrate various press working operations for mass production of sheet metal parts
2. Identify press tool requirements to build concepts pertaining to design of press tools
3. Prepare working drawings and setup for economic production of sheet metal components
4. Select suitable materials for different elements of press tools
5. Illustrate the principles and blank development in bent & drawn components
6. Elaborate failure mechanisms of pressed components, safety aspects and automation in press working

Module	Contents	Hours
1	**Introduction to Press Working** – 1.1 Classification of common Press working operations, Benefits and limitations of using Press tools. Applications of pressed parts/components. 1.2 Theory of Shearing in Press Working. Optimum Cutting clearance & its effect on tolerances of pressed components. Construction of Basic shearing die. Functions of different elements of a press tool. Methods of feeding the strip/coil material.	08
2	**Design and Calculations** of Piercing & Blanking Die– 2.1 Calculations for Economic Strip Layout, Calculations of Cutting force and Stripping force, Recommending minimum tonnage of a press. Centre of Pressure (its importance and calculation) 2.2 Design aspects of Press tool elements viz. Punches & methods of retaining punches, Die block, Stripper, Pilot, etc. Methods of reducing cutting loads on press tools 2.3 Different types Die sets and its selection	14
3	3.1 **Selection of Material & Hardware –**Selection and arrangement of Hardware used in Press tools. Selection of steels and its hardness for different elements of Press tools.	03
4	**Bending and Drawing-** 1.1 Theory of Bending, Spring back and measures to control it, Calculations for Blank development of Simple Bent components, Minimum bend radius, Types of Bending dies 1.2 Theory of Drawing, Metal flow in Drawing & forming operations; reduction ratio and redrawing limits, draw clearance, drawing and blank holding forces for cylindrical draws only. Blank development of Cup 1.3 Defects in drawn as well as bent parts, Presses selection for drawing/forming operations 1.4 Basic construction and working of Bending and Drawing dies	12
5	5.1 **Miscellaneous Dies-** Basic construction & working of Shaving dies, Trimming dies,Compound dies, Combination dies, Coining dies, Embossing dies, Simple Progressive & Compound Progressive dies	05
6	**Selection of Presses and its setting –** 6.1 Selection of Press and Press setting for Shearing, Bending, Progressive and Drawing dies, Equipment for Sheet metal operations (Basics only), Overloading of presses (load, energy considerations) 6.2 Introduction to Automation & Safety in Press shop	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based onapproximately 40% of contents and second test based on remainingcontents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

References

1. Die Design Fundamentals by J. R. Paquin, Industrial Press
2. Techniques of Press Working Sheet Metal by D F Earyand E A Reed
3. Press Tools Design and Construction by P H Joshi, S Chand Publishing
4. Tool Design by C. Donaldson and V C Goold, TMH
5. Production Engineering by P. C. Sharma, S Chand Publishing
6. Metal working ASM Handbook

Course Code	Course Name	Credits
AEDLO5012	Machining Sciences And Tool Design*	4

Objectives

1. To familiarise with the basic concepts of machining science like mechanics of machining, tool wear, tool life and surface roughness.
2. To familiarise with various single and multipoint cutting tools designing processes
3. To study the economics of machining process

Outcomes: Learner will be able to:

1. Calculate the values of various forces involved in the machining operations
2. Design various single and multipoint cutting tools
3. Analyse heat generation in machining operation and coolant operations
4. Illustrate the properties of various cutting tool materials and hence select an appropriate tool material for particular machining application
5. Demonstrate the inter-relationship between cutting parameters and machining performance measures like power requirement, cutting time, tool life and surface finish
6. Analyse economics of machining operations

Module	Details	Hrs.
01	1.1 **Metal Cutting Theory:** Orthogonal and oblique cutting, various types of chips, Mechanics of orthogonal steady state metal cutting, shear plane and shear plane angle, Merchant's force circle, stresses, shear strain, velocity relations, rate of strain, energy considerations, Concept of specific power consumption in machining, Ernst and Merchant's model& modified model for orthogonal cutting, Lee and Shaffer model, Analytical modelling of machining operations, mechanistic modelling of machining, slip line field analysis, finite element analysis, modelling of material properties 1.2 **Dynamometry:** Dynamometer requirements, force measurement, electric transducers, strain gage lathe dynamometer, strain rings, milling dynamometer, drilling dynamometer, surface grinding dynamometer, piezoelectric dynamometry	10
02	2.1 **Temperatures in metal cutting and cutting fluids:** Heat generation in metal cutting, heat transfer in a moving material, temperature distribution in metal cutting, temperature in primary deformation zone, temperature in secondary deformation zone, effect of cutting speed on temperature, prediction of temperature distribution in machining, measurement of cutting temperature, work-tool thermocouple, direct thermocouple measurement, radiation methods, hardness and microstructure changes in steel tools Cutting fluid types, the action of coolants, the action of lubricants, characteristics of an efficient lubricant in metal cutting, application methods of cutting fluid, cutting fluid maintenance and environmental considerations, disposal of cutting fluids, dry cutting and minimum quantity lubrication, cryogenic cooling	06
03	**Cutting tool materials and machining induced surface integrity** 3.1 Properties of cutting tool materials, Major tool material types, Plain carbon steel, high speed steel, cast alloys, cemented tungsten carbide, titanium carbides, ceramic and cermet tools, synthetic diamond, polycrystalline diamond (PCD), cubic boron nitride (CBN), coated tools 3.2 Measurement and specification of surface finish, primary cutting edge finish, fracture roughness, BUE formation and its influence on finish, secondary cutting edge finish,	06

	geometrical contribution to roughness, edge finishing, residual stress and micro hardness	
04	4.1 **Tool life and machining economics:** Definition, flank wear and crater wear, criteria for tool failure, effect of cutting parameters and tool geometry on tool life, Taylor's tool life equation, Experimental methods to find Taylor exponents, Components of product cost,Optimum cutting velocity for minimum cost of production and maximum production rate	**06**
05	5.1 **Design of single point cutting tools** : Different systems of tool nomenclature like MRS, ORS and NRS, Interrelationship among different systems of nomenclature for tool angles, Constructional features of solid tool, tipped tools, mechanically held regrind able insert type tools and throw away tip type tools, Design of shanks, cutting tip and chip breakers for HSS and Carbide tools, ISO coding system for tipped tools and tool holders	**08**
06	6.1 **Design of multi point cutting tools :** Various types such as flat form tool, tangential form tool, circular form tool, constructional details and fields of application, Profile design of flat and circular form tools,Broach nomenclature, design steps for circular pull type, key way and spline broaches, Design of face and peripheral milling cutters	**10**

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based onapproximately 40% of contents and second test based on remainingcontents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

References

1. Fundamentals of Metal Machining and Machine Tools, Third Edition by Winston A. Knight, Geoffrey Boothroyd, CRC press Taylor and Francis group
2. Metal Cutting Principles by Milton Clayton Shaw,2nd Edition, Oxford University Press
3. Cutting Tools by P H Joshi, A H Wheeler Publishing Co Ltd
4. ASM Handbook, Vol. 16: Machining by Joseph R. Davis,9th Edition, ASM International
5. Fundamentals of Metal Cutting and Machine Tools by B. L. Juneja, G. S. Sekhon and Nitin Seth,2nd Edition, New Age International
6. Metal Cutting Theory and Cutting Tool Design, by V. Arshinov and G. Alekseev, Mir publishers, Moscow
7. Typical Examples and Problems in Metal Cutting and Tool Design, by N. Nefedov and K. Osipov, Mir publishers, Moscow

Course Code	Course Name	Credits
AEDLO5013	Design of Jigs and Fixtures*	4

Objectives

1. To acquaint with the concepts of planning and writing sequence of operations
2. To acquaint basics of identification and selection of location and clamping points on work-piece
3. To familiarise design principles in designing simple productive and cost effective jigs and fixtures

Outcomes: Learner will be able to…

1. Write methodically, thesequence of operations of simple work-piece
2. Identify and select locating and clamping points on work-piece
3. Demonstrate construction of drill jig
4. Illustrate construction of milling fixture
5. Identify appropriate combination of tools, jigs and fixture, suitable for a particular machining operation
6. Design assembly of jigs and fixtures on simple work-piece

Module	Details	Hrs
01	1.1 **Introduction to Tool Design** Production Tooling's Jigs, Fixtures and their difference, their requirement(accuracy, machinability, quantity modifications so as toassist production, Interchange ability, Simplicity, Swarf disposal,Handling, Ease of operation, Skill reduction, Cost reduction), Analysis forOperation planning, sequencing of operations.	08
02	**Basic Construction of Jig & Fixture** 1.1 **Location & Locating Devices** Locating principles: Degrees of freedom, Redundant location, Fool-proofing, nesting, Locators: locators that control work piece on flat surfaces, location of cylindrical surfaces, conical locators, centralizers. 1.2 **Clamping & clamping Devices** Requirement of clamping system, Position of clamps, Types of clamps, Clamping devices; examples of typical clamps(multiple clamping and equalizing devices, quick acting clamping mechanisms such as link, toggle, cam, eccentric, pneumatic, hydraulic and electric devices), Component distortion under clamping and cutting forces, Material used for different clamping devices of jigs/fixture and recommended hardness	10
03	3.1 **Construction of Drill Jig** Introduction, Selection of location, supporting and clamping faces /points, cutting tools and means of guiding and supporting Jigs, varioustypes of Jig Bushes, Commonly used drill jigs, Case Study on Design of Drill Jig	10
04	4.1 **Construction of Milling fixture** Introduction, Selection of location, supporting and clamping faces /points choice, tool setting block and Tennon's, Case Study on Design of Milling Fixture	08
05	5.1 **Introduction to Commonly used Fixtures** Turning Fixture (Chucks, collets, Mandrels) Grinding Fixture, BroachingFixture, and Welding Fixture	08
06	6.1 **Indexing Jig & Fixture** Introduction, Application of indexing, Essential features of an indexing jig /fixture, Indexing Devices	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based onapproximately 40% of contents and second test based on remainingcontents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References

1. Jig and Fixture Design Manual, Erik K. Henrikson, Industrial Press
2. An introduction to jig and tool Design, MH A Kempster, 3rd Edition, ELBS
3. Jigs and Fixture, P. H. Joshi, TMH
4. Tool design, C. Donaldson, George H. Lecain, V.C. Goold, TMH
5. Jigs and Fixture Handbook, A.K. Goroshkin, Mir Publication
6. Jigs and Fixture, ASTME
7. Non- Standards Calming Devices, Hiran E. Grant TMH, New Delhi

Course Code	Course Name	Credits
AEL 501	Internal Combustion Engines Lab*	01

Objectives:

1. To familiarise concept of thermal conductivity, heat transfer coefficient through experiments
2. To familiarise experimental verification of the concepts of heat transfer

Outcomes: Learner will be able to ….

1. Dismantle engine assembly
2. Overhaul and Assemble engine components
3. Perform load test/speed test on engine setup
4. Calculate performance of multi cylinder engine
5. Analyse engine performanceand draw heat balance sheet
6. Perform exhaust gas analysis

Part A: Dismantle, overhaul and assemble the following

1. 2 Stroke/ 4 Stroke Engines
2. Carburettor
3. Ignition system
4. Fuel injection system

Part B: Performing experiments on engine test rigs

1. Morse Test on petrol engine
2. Speed Test on petrol or/and diesel engine
3. Load Test on diesel engine (engines)
4. Heat Balance test on diesel or petrol engines
5. Experimental determination of Air fuel ratio and volumetric efficiency of the engine
6. Exhaust Gas/Smoke analysis of S.I./ C.I. engines
7. Effect of Supercharging on Performance Characteristics of an engine

Term Work

Term work shall consist of minimum 6 exercises, from the list, out of which minimum 4 must be actual experiments from Part B and 1 case study/report (in group of not more than 3 students) on latest trends/developments in IC Engines.

The distribution of marks for term work shall be as follows:

1. Laboratory work (Exercises) : **15 marks**
2. Case study: **05 marks**
3. Attendance: **05 marks**

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/Oral based on contents
2. Distribution of marks for practical/Oral examination shall be as follows:
   - Practical performance 15 marks
   - Oral 10 marks
3. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course/Subject Name	Credits
AEL 502	Mechanical Measurement and Control*	1

Objectives

1. To study calibration of different measuring instruments
2. To study working of mechanical measurement system
3. To familiarise with different types of control systems

Outcomes: Learner will be able to…

1. Calibrate displacement sensors
2. Calibrate pressure and vacuum gauges
3. Measure torque using strain gauges
4. Identify system/process characteristics for standard input responses
5. Identify various types of control systems and time domain specifications
6. Analyse the problems associated with stability

List of Experiments

Sr. No.	Topic
1	Calibration of Displacement sensors like LVDT, Potentiometers etc.
2	Calibration of Pressure Gauges
3	Calibration of Vacuum Gauges
4	Torque measurement using strain gauges
5	Calibration of tachometers
6	Vibration Measurement & Calibration of Accelerometers.
7	Experiments on feedback control systems and servomechanisms
8	System Identification of any one of the sensor
9	Experiment on frequency response system identification
10	Experiment on transient state response of a control system.
11	Experiment on design of PID controller for a system.

(a) Design based experiments shall be encouraged using standard National Instrument/ texas instrument/ dSPACEGmbh/ Arduino or any other platform),**Learners (in a group) may be encouraged for Project Based Learning. Appropriate weightage may be given in term work assessment**

Term Work

Term work shall consist of minimum 8experiments (04 from the measurement group and 4 from the control group),
The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments) **:** **15 marks**
- Design based experiment: **05 marks**
- Attendance**:** **05 marks**

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/Oral based on contents
2. Distribution of marks for practical/Oral examination shall be as follows:
   Practical performance 15 marks
   Oral 10 marks
3. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination
4. Students work along with evaluation report to be preserved till the next examination

Subject Code	Subject Name	Credits
AEL 503	Heat Transfer Lab*	01

Objectives:

1. To familiarise concept of thermal conductivity, heat transfer coefficient through experiments
2. To familiarise experimental verification of the concepts of heat transfer

Outcomes: Learner will be able to ….

1. Estimate thermal conductivity of metals/non metals/liquids
2. Compute heat transfer coefficient in natural as well forced convection
3. Measure emissivity of grey body
4. Quantify fin effectiveness/efficiency
5. Analyse heat exchanger performance
6. Demonstrate energy balance for heat exchanger

The laboratory experiments should be based on the following:

Exp.No	Name of Experiments	Time
1	**Conduction: (Any Two)** 1. Measurement of thermal conductivity of metal rod 2. Measurement of thermal conductivity of insulating material 3. Measurement of thermal conductivity of liquid 4. Determination of contact resistance 5. Effect of area on heat transfer	2Hrs
2	**Convection: (Any One)** 1. Measurement of heat transfer coefficient in natural convection 2. Measurement of heat transfer coefficient in forced convection 3. Comparison of heat transfer coefficient of free and forced convection	2Hrs
3	**Radiation: (Any One)** 1. Verification of Stefan Boltzmann Law 2. Measurement of Emissivity of Grey surface	2Hrs
4	**Transient Conduction:** 1. Unsteady state heat transfer in cylinder/rod/wall	2Hrs
5	**Fins: (Any One)** 1. Determination of fin efficiency and fin effectiveness 2. Comparison of fin performance of Various type of fins	2Hrs
6.	**Boiling and Condensation: (Any One)** 1. Measurement of heat transfer coefficient in boiling process of water. 2. Measurement of heat transfer coefficient in condensation of saturated steam.	2Hrs
7	**Heat Exchangers: (Any One)** 1. Estimation of overall heat transfer coefficient and effectivenessof double pipe heat exchanger (parallel flow and Counter flow arrangement) 2. Estimation of overall heat transfer coefficient and effectivenessof shell and tube heat exchanger (parallel flow and Counter flow arrangement) 3. Estimation of overall heat transfer coefficient and effectiveness of plate type heat exchanger.	2Hrs

Assignments: Assignment consisting of at least 3 numerical on each of the following topics

1. Steady state conduction
2. Fins and unsteady state conduction
3. Convection and dimensional analysis

4. Radiation
5. Heat Exchangers

Note: Preferably, the assignments shall be based on live problems. **Project Based Learning may be incorporated by judiciously reducing number of assignments.**

Assessment:

Term work Mark distribution will be as follows:

Laboratory work	15 marks
Assignments	05 marks
Attendance	05 marks

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/Oral based on contents Distribution of marks for practical/Oral examination shall be as follows:

Practical performance	15 marks
Oral	10 marks

2. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination
3. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
AEL504	Automotive Systems	1

Objectives:

1. To help student better understand Automotive systems and subsystems through cut section models and Case studies
2. To give hands on experience to students on different automotive systems through Dismantling and Assembly
3. To Understand latest developments in automotive systems technology.

Outcomes: Learner will be able to

1. Identify Automobile systems and subsystems.
2. Dismantle and assemble Clutch
3. Dismantle and assemble Gearbox
4. Dismantle and assemble Propeller shaft
5. Dismantle and assemble Steering Gearbox
6. Dismantle and assemble Differential

Term Work :(Comprises both A & B)

A.List of Experiments

1. Dismantling and reassembling of Clutch.
2. Dismantling and reassembling of Gear box.
3. Dismantling and reassembling of Propeller Shaft.
4. Dismantling and reassembling of Differential.
5. Dismantling and reassembling of Steering gear linkages and steering gear box.
6. Dismantling and reassembling of any one type of braking systems.

B.Case Studies

Assign case studies for each student on *any one* of the following topics:

1. **Four wheelers**: Light and Heavy vehicles (Passenger and Commercial)
2. **Three wheelers**: Case study of Indian models. Front mounted engine and rear mounted engine types. Auto rickshaws, Pick up van, Delivery van and Trailer, Bijli electric vehicle.
3. **Two wheelers**: Case study of major Indian models of major motor cycles, scooters and mopeds.
4. **Off Road Vehicles:** Case study regarding working principle and construction of each-Earth Moving Machines, Scrappers, Graders, Shovels and Ditchers, Farm Equipment's, Military and Combat Vehicles.

The distribution of marks for term work shall be as follows:

1) Part A: **10 marks**

2) Part B: **10 marks**

3) Attendance (Theory and Practical): **05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/Oral based on contents Distribution of marks for practical/Oral examination shall be as follows:

Practical performance	15 marks
Oral	10 marks

2. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination

Students work along with evaluation report to be preserved till the next examination

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Course Code	Course Name	Credits
AEL 505	Manufacturing Sciences Lab*	1

Objectives:

1. To study conventional machining operations
2. To familiarise with CNC machining operation
3. To acquaint with Non Traditional machining operations

Outcomes: Learner will be able to …

1. Estimate machining time forsimple and taper turning operations on lathe
2. Estimate machining time for threading/knurling operations on lathe
3. Estimate machining time for various machining operations on shaper
4. Perform NC, CNC and DNC machining operations
5. Write CNC program for different operations
6. Identify machining parameters for various Non Traditional machining operations

Sr No.	Details
1	Introduction to machining operations
2	Introduction to lathe machine (other than plain turning operation) and shaping machine
3	Machining and machining time estimation for taper turning
4	Machining and machining time estimation for thread cutting
5	Machining and machining time estimation for internal thread cutting
6	Machining and machining time estimation for knurling
7	Machining and machining time estimation for eccentric turning
8	Machining of hexagon and square in shaping machine
9	NC, CNC, DNC machining operations
10	CNC programming for Turning and Drilling operations
11	Different Non Traditional machining operations with process parameters

Term Work:

All the assignments mentioned above with relevant sketches.

The distribution of marks for Term work shall be as follows:

All the above listed assignments: **20 marks**

Attendance: **05 marks**

Subject Code	Subject Name	Credits
MEL506	**Business Communication & Ethics**	**02**

Objectives:

1. To inculcate professional and ethical attitude at the workplace
2. To enhance effective communication and interpersonal skills
3. To build multidisciplinary approach towards all life tasks
4. To hone analytical and logical skills for problem-solving

Outcomes: Learner will be able to…

1. Design a technical document using precise language, suitable vocabulary and apt style.
2. Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
3. Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
4. Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
5. Deliver formal presentations effectively implementing the verbal and non-verbal skills

Module	Detailed Contents	Hrs.
01	**Report Writing**	**05**
1.1	Objectives of Report Writing	
1.2	Language and Style in a report	
1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility)and Formats of reports (Memo, Letter, Short and Long Report)	
02	**Technical Writing**	**03**
2.1	Technical Paper Writing (IEEE Format)	
2.2	Proposal Writing	
03	**Introduction to Interpersonal Skills**	**09**
3.1	Emotional Intelligence	
3.2	Leadership and Motivation	
3.3	Team Building	
3.4	Assertiveness	
3.5	Conflict Resolution and Negotiation Skills	
3.6	Time Management	
3.7	Decision Making	
04	**Meetings and Documentation**	**02**
4.1	Strategies for conducting effective meetings	
4.2	Notice, Agenda and Minutes of a meeting	
4.3	Business meeting etiquettes	
05	**Introduction to Corporate Ethics**	**02**
5.1	Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.	
5.2	Introduction to Intellectual Property Rights	
5.4	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
06	**Employment Skills**	**07**
6.1	Group Discussion	
6.2	Resume Writing	
6.3	Interview Skills	

6.4	Presentation Skills	
6.5	Statement of Purpose	

Assessment:

List of Assignments

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

Term Work

Term work shall consist of all assignments from the list.

The distribution of marks for term work shall be as follows:

Book Report	**10 marks**
Assignments:	**10 marks**
Project Report Presentation:	**15 marks**
Group Discussion:	**10 marks**
Attendance:	**05 marks**

References:

1. Fred Luthans, "Organizational Behavior", Mc Graw Hill,
2. Lesiker and Petit, "Report Writing for Business*"*, Mc Graw Hill
3. R.Subramaniam, "Professional Ethics" Oxford University Press
4. Huckin and Olsen, "Technical Writing and Professional Communication", McGraw
5. Raman and Sharma, Fundamentals of Technical Communication, Oxford University Press
6. Hill Wallace and Masters, "Personal Development for Life and Work", Thomson Learning, 12th Edition
7. Heta Murphy, "*Effective Business Communication"* , Mc Graw Hill, edition
8. R.C Sharma and Krishna Mohan, "*Business Correspondence and Report Writing",*
9. Raman Sharma, *Communication Skills*, Oxford University Press
10. B N Ghosh, "*Managing Soft Skills for Personality Development*", Tata McGraw Hill Lehman,
11. Dufrene, Sinha, "*BCOM*", Cengage Learning, 2nd edition
12. Bell . Smith, "Management Communication" Wiley India Edition, 3rd edition
13. Dr. K. Alex ,"Soft Skills", S Chand and Company
14. Robbins Stephens P., "Organizational Behavior", Pearson Education
15. https://grad.ucla.edu/asis/agep/advsopstem.pdf