FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(AICTE Model Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. III and IV Semester

of

Four Year Degree Programme

in

Automobile Engineering

(With effect from the academic year 2019– 2020)
(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Automobile Engineering) III – SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	MC111PO	Indian Constitution	2	-	-	2	30	70	3	-
2	HS201EG	Effective Technical Communication in English	3	-	-	3	30	70	3	3
3	HS202CM	Finance and Accounting	3	-	-	3	30	70	3	3
4	BS205MT	Mathematics-III (PDE, Probability & Statistics)	3	-	-	3	30	70	3	3
5	ES211CE	Engineering Mechanics	2	1	-	3	30	70	3	3
6	ES214EC	Basic Electronics	3	-	-	3	30	70	3	3
7	PC223AE	Fluid Mechanics and Machinery	3	-	-	3	30	70	3	3
8	PC224AE	Thermal Engineering	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
9	PC252ME	Machine Drawing and Modelling Lab	-	-	2	2	25	50	3	1
10	PC253AE	Fluid Power Lab	-	-	2	2	25	50	3	1
			22	**01**	**04**	**27**	**290**	**660**		**23**

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
MC: Mandatory Course PC: Professional Core
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam)
PO: Political Science, EG: English, CM: Commerce, MT: Mathematics, CE: Civil Engineering,
EC: Electronics and Communication Engineering, ME: Mechanical Engineering, AE: Automobile Engg.

Note:

1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.
3. All the mentioned **Mandatory Courses** should be offered either in I–Semester or II–Semester only **from the academic year 2019-2020**.
4. For those of the students admitted during the academic year 2018-2019, since the Mandatory Courses were not offered during the I–Semester or II–Semester, they should be offered either in III–Semester or IV–Semester of the **academic year 2019-2020.**

Course Code	Course Title						Core/Elective
MC111PO	**Indian Constitution**						**Mandatory**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**2**	**-**	**-**	**-**	**30**	**70**	**-**

Course Objectives

- To create awareness among students about the Indian Constitution.
- To acquaint the working conditions of union, state, local levels, their powers and functions.
- To create consciousness in the students on democratic values and principles articulated in the constitution.
- To expose the students on the relations between federal and provincial units.
- To divulge the students about the statutory institutions.

Course Outcomes

After completing this course, the student will

1. Know the background of the present constitution of India.
2. Understand the working of the union, state and local levels.
3. Gain consciousness on the fundamental rights and duties.
4. Be able to understand the functioning and distribution of financial resources between the centre and states.
5. Be exposed to the reality of hierarchical Indian social structure and the ways the grievances of the deprived sections can be addressed to raise human dignity in a democratic way.

UNIT-I

Evolution of the Indian Constitution: 1909 Act, 1919 Act and 1935 Act. Constituent Assembly: Composition and Functions; Fundamental features of the Indian Constitution.

UNIT-II

Union Government: Executive-President, Prime Minister, Council of Minister
State Government: Executive: Governor, Chief Minister, Council of Minister
Local Government: Panchayat Raj Institutions, Urban Government

UNIT-III

Rights and Duties: Fundamental Rights, Directive principles, Fundamental Duties

UNIT-IV

Relation between Federal and Provincial units: Union-State relations, Administrative, legislative and Financial, Inter State council, NITI Ayog, Finance Commission of India

UNIT-V

Statutory Institutions: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women

Suggested Readings:

1. Abhay Prasad Singh & Krishna Murari, Constitutional Government and Democracy in India, Pearson Education, New Delhi, 2019
2. D.D. Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi
3. Subhash Kashyap, Our Parliament, National Book Trust, New Delhi
4. Peu Ghosh, Indian Government &Politics, Prentice Hall of India, New Delhi
5. B.Z. Fadia & Kuldeep Fadia, Indian Government &Politics, Lexis Nexis, New Delhi

Course Code	Course Title						Core/Elective
HS201EG	**Effective Technical Communication in English**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To expose the students to:

- Features of technical communication
- Types of professional correspondence
- Techniques of report writing
- Basics of manual writing
- Aspects of data transfer and presentations.

Course Outcomes

On successful completion of the course, the students would be able to:

1. Handle technical communication effectively
2. Use different types of professional correspondence
3. Use various techniques of report writing
4. Acquire adequate skills of manual writing
5. Enhance their skills of information transfer and presentations

UNIT I

Definition and Features of Technical communication: Definition and features of technical communication (precision, relevance, format, style, use of visual aids), Differences between general writing and technical writing, Types of technical communication (oral and written)

UNIT II

Technical Writing-I (Official correspondence): Emails, IOM, Business letters, Business proposals.

UNIT III

Technical writing-II (Reports): Project report, Feasibility report, Progress report, Evaluation report.

UNIT IV

Technical writing- III (Manuals): Types of manuals, User manual, Product manual, Operations manual.

UNIT V

Information Transfer and Presentations: Non-verbal (bar diagram, flow chart, pie chart, tree diagram) to verbal (writing), Verbal (written) to non-verbal, Important aspects of oral and visual presentations.

Suggested Readings:

1. Raman, Meenakshi & Sharma, Sangeeta. (2015). *Technical Communication: Principles and Practice*(3rd ed.), New Delhi.
2. Rizvi,Ashraf, M. (2017).*Effective Technical Communication*(2nd ed.), Tata McGraw Hill Education, New Delhi.
3. Sharma, R. C., & Mohan, Krishna. (2017). *Business Correspondence and Report Writing: A Practical Approach to Business & Technical Communication* (4th ed.). New Delhi, Tata McGraw Hill Education.
4. Tyagi, Kavita &Misra, Padma. (2011). *Advanced Technical Communication*. New Delhi, PHI Learning.
5. Jungk, Dale. (2004).*Applied Writing for Technicians.* New York, McGraw-Hill Higher Education.

Course Code	Course Title						Core/Elective
HS202CM	**Finance and Accounting**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The course will introduce the students

- To provide basic understanding of Financial and Accounting aspects of a business unit
- To provide understanding of the accounting aspects of business
- To provide understanding of financial statements
- To provide the understanding of financial system
- To provide inputs necessary to evaluate the viability of projects
- To provide the skills necessary to analyse the financial statements

Course Outcomes

After successful completion of the course the students will be able to

1. Evaluate the financial performance of the business unit.
2. To take decisions on selection of projects.
3. Take decisions on procurement of finances.
4. Analyse the liquidity, solvency and profitability of the business unit.
5. Evaluate the overall financial functioning of an enterprise.

UNIT-I

Basics of Accounting: Financial Accounting–Definition- Accounting Cycle – Journal - Ledger and Trial Balance-Cash Book-Bank Reconciliation Statement (including Problems)

UNIT-II

Final Accounts: Trading Account-Concept of Gross Profit- Profit and Loss Account-Concept of Net Profit-Balance Sheet (including problems with minor adjustments)

UNIT-III

Financial System and Markets: Financial System-Components-Role-Considerations of the investors and issuers- Role of Financial Intermediaries. Financial Markets-Players- Regulators and instruments - Money Markets Credit Market- Capital Market (Basics only)

UNIT-IV

Basics of Capital Budgeting techniques: Time Value of money- Compounding- Discounting- Future Value of single and multiple flows- Present Value of single and multiple Flows- Present Value of annuities- Financial Appraisal of Projects– Payback Period, ARR- NPV, Benefit Cost Ratio, IRR (simple ratios).

UNIT-V

Financial statement Analysis: Financial Statement Analysis- Importance-Users-Ratio Analysis-liquidity, solvency, turnover and profitability ratios.

Suggested Readings:

1. Satyanarayana. S.V. and Satish. D., Finance and Accounting for Engineering, Pearson Education
2. Rajasekharan, Financial Accounting, Pearson Education
3. Sharma.S.K. and Rachan Sareen, Financial Management, Sultan Chand
4. Jonathan Berk, Fundamentals of Corporate Finance, Pearson Education
5. Sharan, Fundamentals of Financial Management, Pearson Education

Course Code	Course Title						Core/Elective
BS205MT	**Mathematics – III (PDE, Probability & Statistics)**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
- To provide an overview of probability and statistics to engineers

Course Outcomes

After completing this course, the student will be able to:

1. Solve field problems in engineering involving PDEs.
2. They can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

UNIT-I: Formation of Partial Differential Equations, First order partial differential equations, solutions of first order linear Partial Differentiation Equations, Lagranges's equation, Non-linear First Order equations, Charpit's method.

UNIT-II: Second-order linear equations and their classification, Method of separation of variables, vibration of stretched string wave equation, one dimensional heat equation, two dimensional heat equation, solution of Laplace's equation.

UNIT-III: Probability distributions: Poisson, Uniform and Normal distributions, Mean, variance, moment generating function and evaluation of statistical parameters for these distributions, Moments, Skewness and Kurtosis.

UNIT-IV: Curve fitting by the method of least squares: Fitting of straight lines, second degree parabolas and more general curves, Correlation, regression and Rank correlation. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

UNIT-V: Test for single mean, difference of means and correlation coefficients, test for ratio of variances , Chi-square test for goodness of fit and independence of attributes.

Suggested Readings:

1. R.K.Jain & Iyengar, "Advanced Engineering Mathematics", Narosa Publications.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000.
3. P.Sivaramakrishna Das & C.Vijaya Kumar, "Engineering Mathematics" , Pearson India Education Services Pvt. Ltd.
4. N.P. Bali & M. Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, 2010.
5. S.C.Gupta & V.K.Kapoor, "Fundamentals of Mathematical Statistics" , S.Chand Pub.
6. P. G. Hoel, S. C. Port & C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
7. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.

Course Code	Course Title						Core/Elective
ES211CE	**Engineering Mechanics**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**2**	**1**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The objectives of this course is to impart knowledge of

- Resolution of forces, equilibrium of force systems consisting of static loads
- Obtaining centroids and moments of inertia for various regular and irregular areas.
- Various forces in the axial force members, and to analyse the trusses using various methods,
- Concept of friction for single and connected bodies.
- Basic concepts of dynamics, their behavior, analysis and motion bodies
- Work energy principles and impulse momentum theory and applications to problem solving

Course Outcomes

After completing this course, the student will be able to:

1. Apply the fundamental concepts of forces, equilibrium conditions for static loads.
2. Determine the centroid and moment of inertia for various sections.
3. Analyse forces in members of a truss using method of joints and method of sections, analyse friction for single and connected bodies.
4. Apply the basic concepts of dynamics, their behavior, analysis and motion bodies.
5. Solve problems involving work energy principles and impulse momentum theory.

UNIT – I

Introduction to Engineering Mechanics: Basic Concepts

System of Forces: Coplanar Concurrent Forces, Components in Space – Resultant of coplanar and spatial systems, Moment of Force and Couple and its Application to coplanar system

Equilibrium of Systems of Forces: Free Body Diagrams, Equations of Equilibrium and applications to Coplanar System.

UNIT – II

Centroid: Centroid of simple areas (from basic principles), Centroid of Composite areas.

Area Moment of Inertia: Definition, Moment of inertia of simple areas (from basic principles), Polar Moment of Inertia, Transfer formula, Moment of Inertia of Composite areas.

Centre of Gravity & Mass moment of Inertia: Centre of gravity and Mass moment of inertia of simple bodies (from basic principles).

UNIT-III

Friction: Theory of friction, Laws of friction, Friction connected to single and connected bodies. Wedge friction.

Analysis of Perfect Frames: (Analytical Method) Types of Frames, Assumptions for forces in members of perfect frame, Method of joints and Method of sections for Cantilever Trusses, simply supported Trusses.

UNIT –IV

Kinematics: Introduction, Motion of particle, Rectilinear and Curvilinear motions, Velocity and Acceleration, Types of Rigid body, Angular motion, Fixed axis rotation.

Kinetics: Introduction, fundamental equation of kinetics for a particle, D' Alembert's principle for particle motion, connected system and Fixed Axis Rotation.

UNIT – V

Work - Energy Method: Introduction, Equations for Translation, Work-Energy Applications to Particle Motion, Connected System and Fixed Axis Rotation.

Impulse Momentum Method: Linear impulse momentum, law of conservation of momentum, coefficient of restitution, Elastic impact**.**

Suggested Readings:

1. Ferdinand L. Singer, *Engineering Mechanics*, Collins, Singapore, 1975.
2. Reddy Vijay Kumar K. and K. Suresh Kumar, Singer's Engineering Mechanics, 2010.
3. S.S Bhavakatti, *Engineering Mechanics*, New age International publishers.
4. Rajeshakharam, S. and Sankarasubrahmanyam, G., *Mechanics,* Vikas Publications, 2002.
5. Junarkar, S.B. and H.J. Shah., *Applied Mechanics*, Publishers, 2001.

Course Code	Course Title						Core/Elective
ES214EC	**Basic Electronics**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The objectives of this course is to impart knowledge of

- To understand the characteristics of diodes and transistor configurations
- To understand the design concepts of biasing of BJT and FET
- To understand the design concepts of feedback amplifiers and oscillators
- To study the design concepts of OP Amp and data converters

Course Outcomes

After completing this course, the student will be able to:

1. Study and analyse the rectifiers and regulator circuits.
2. Study and analyse the performance of BJTs, FETs on the basis of their operation and working.
3. Ability to analyse & design oscillator circuits.
4. Ability to analyse different logic gates & multi-vibrator circuits.
5. Ability to analyse different data acquisition systems

UNIT-I

PN Junction Diode: Characteristics, Half wave rectifier, Full wave rectifier, filters, ripple, regulation, TIF and efficiency, Zener diode and Zener diode regulators. CRT construction and CRO applications

UNIT-II

Transistors: BJT construction and working, modes of operation, configurations of BJT (CB, CE, CC), small signal h-parameter model of CE, CE amplifier analysis. Construction and working of JFET, V-I characteristics of JFET.

UNIT-III

Feedback concepts: Types of negative feedback – modification of gain, bandwidth, input and output impedances, applications.

Oscillators: RC Phase shift, Wein bridge, LC and crystal Oscillators (Qualitative treatment only).

UNIT-IV

Operational Amplifier: OP-AMP Block diagram, Ideal OP-AMP, DC and AC Characteristics, Inverting and Non-Inverting Amplifiers, Adder/Subtractor, Integrator, Differentiator.

Logic gate circuits - Introduction to Digital systems- AND, NAND, NOR, XOR gates, Binary half adder, full adder.

UNIT-V

Data Acquisition Systems: Construction and Operation of transducers- Strain guage LVDT, Thermocouple, Instrumentation systems.

Data Converters: R-2R Ladder DAC, Successive approximation and Flash ADC.

Suggested Readings:

1. Robert Boylestad L. and Louis Nashelsky, *Electronic Devices and Circuit Theory*, PHI, 2007
2. Helfrick D and David Cooper, *Modern Electronic Instrumentation and Measurements Techniques,* 1st edition, Prentice Hall of India, 2006.
3. Salivahanan, Suresh Kumar and Vallavaraj, *Electronic Devices and Circuits*, 2nd edition, Tata McGraw-Hill, 2010.

Course Code	Course Title						Core/Elective
PC223AE	**Fluid Mechanics and Machinery**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

It is intended to make the students to

- Know various fluid properties, concepts and methods of fluid measurement.
- Understand the basic concepts and principle of fluid flow.
- Study different equations of fluid motion and fluid dynamics.
- Analyse different flow characteristics of laminar flows.
- Understand the working principle of hydraulic turbines and pumps and their performance.

Course Outcomes

After the completion of this unit, the student is able to

1. Distinguish the properties of the fluids and different types of pressure and measure them
2. Explain different types of flows and analyse them.
3. Analyse the flow between parallel plates and in pipes and also calculate drag and lift coefficients.
4. Demonstrate the working principles of various turbines and estimate their performance.
5. Demonstrate the working principles of various pumps and estimate their performance.

UNIT-I

Basic Concepts and Properties of Fluid: Definition, distinction between solid and fluid, Properties of fluids, density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension, units and dimensions.

Fluid statics: Concept of fluid static pressure, absolute and gauge pressures, pressure measurements by manometers and pressure gauges.

UNIT-II

Fluid Kinematics: Flow visualization, lines of flow, types of flow, velocity field and acceleration, Continuity equation (one and three-dimensional differential forms), Equation of streamline, stream function, velocity potential function, circulation, flow net.

Fluid Dynamics: Equations of motion, Euler's equation along a streamline, Bernoulli's equation, applications. Venturi meter, Orifice meter, Pitot tube, dimensional analysis,

UNIT-III

Incompressible Fluid Flow: Viscous flow, Navier-Stoke's equation (Statement only), Shear stress-pressure gradient relationship, laminar flow between parallel plates, Laminar flow through circular tubes (Hagen poiseulle's), Hydraulic and energy gradient lines.

Flow through pipes: Darcy- Weisback's equation, pipe roughness, friction factor, minor losses, flow through pipes in series and in parallel, power transmission, Boundary layer flows, boundary layer thickness, boundary layer separation, drag and lift coefficients.

UNIT-IV

Hydraulic Turbines: Definition and classifications, Pelton turbine, Francis turbine, propeller turbine, Kaplan turbine, working principles, velocity triangles, work done, specific speed. Efficiencies, performance curve for turbines.

UNIT-V

Hydraulic Pumps: Definition and classifications, Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves. Reciprocating pump: classification, working principles, indicator diagram, performance curves, cavitation in pumps, Rotary pumps: working principles of gear and vane pumps

Suggested Readings:

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 1983.
2. Modi & Seth "Hydraulic and Fluid Mechanics" – standard book house, 2002.
3. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5^{th} edition), Laxmi publications (P) Ltd. Delhi, 1995.
4. Kumar D. S., "Fluid Mechanics and Fluid Power Engineering", S. K. Kataria & Sons.
5. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5^{th} Edition, New Delhi, 2003.
6. Som, S.K., and Biswas, G., "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2^{nd} edition, 2004.

Course Code	Course Title						Core/Elective
PC224AE	**Thermal Engineering**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

It is intended to make the students to

- Understand Thermodynamics systems, Thermodynamics properties, energy interactions in the form of work and heat and apply first law of thermodynamics for open and closed systems
- Understand the concept of Second law of Thermodynamics, entropy and Carnot theorem and acquire knowledge about heat engine, heat pump and refrigerator.
- Understand the Brayton cycle and methods to improve its efficiency and also steady flow of gases through nozzles and diffusers.
- Understand working of air compressor, study the effect of clearance volume on volumetric efficiency and power required and learn different types of refrigeration systems.
- Understand and represent phase change of a pure substance and also acquire the knowledge about fuel cells and hybrid vehicles.

Course Outcomes

After the completion of this unit, the student is able to

1. Distinguish thermodynamic systems, apply Zeroth law for temperature measurement and find first law of thermodynamics for closed and open systems
2. Apply second law of thermodynamics to heat engine, heat pump and refrigerator to find their performance and determine entropy changes for a closed system.
3. Determine thermal efficiency of Brayton cycle, apply methods to improve thermal efficiency and solve problems related to flow through nozzles and diffusers.
4. Calculate the power required to run compressor, analyse the effect of clearance volume and multistage compression on volumetric efficiency and work of compression and also demonstrate different types of refrigeration systems.
5. Demonstrate the phase change of pure substance, evaluate the properties of steam and performance of Rankine Cycle and explain about fuel cells and hybrid vehicles.

UNIT-I

First Law of Thermodynamics

System, thermodynamic equilibrium, state, property, process, cycle, Zeroth law of thermodynamics, energy, work, heat, first law of thermodynamics, PMM I, ideal gases, application of first law of thermodynamics to closed and open systems, pressure – volume diagrams, steady flow process, application of steady flow energy equation.

UNIT-II

Second Law of Thermodynamics

Limitations of first law, statements of second law of thermodynamics, PMM II, Clausius inequality, heat engine, heat pump, refrigerator, Carnot cycle, Carnot theorem, entropy, temperature – entropy diagram, entropy changes for a closed system.

UNIT-III

Gas Power Cycles, Fluid Flow

Air Standard Brayton cycle – Analysis, Performance improvement Methods- Intercooling, Reheating and Regeneration. One-dimensional steady flow of gases and steam flow through nozzles and diffusers.

UNIT-IV

Properties of Pure Substance, Refrigeration Cycles

Concept of phase change, graphical representation on p-v, p-T, T-h and T-s diagrams, properties of steam, Use of steam tables and Mollier diagram. Rankine Cycle – Analysis.

Fundamentals of Refrigeration, COP, Reversed Carnot cycle, simple vapour compression refrigeration system, T-S, P-H diagrams, simple vapour absorption refrigeration system, desirable properties of an ideal refrigeration.

UNIT-V

Reciprocating Air Compressors, Fuel cells and Hybrid Vehicles

Single acting and double acting air compressors, work required, effect of clearance volume, volumetric efficiency, isothermal efficiency, free air delivery. Multistage compression, condition for minimum work. Fuel Cell Technology for Vehicles: Types of fuel cells, working principle, Advantages of fuel cells, Current state of the technology. Potential and challenges. Advantages and disadvantages of hydrogen fuel.

Hybrid Vehicles: Types of hybrid systems, Objectives and Advantages of hybrid systems. Current status, Future developments and prospects of Hybrid Vehicles.

Suggested Reading:

1. R. K. Rajput, “Text book of Engineering Thermodynamics”. Laxmi Publications (p) Ltd, New Delhi, 2001.
2. Mahesh M Rathore, “Thermal Engineering”, Mc Graw Hill Education (India) Private Limited.
3. P. K. Nag, “Engineering Thermodynamics”, Tata Mc Graw Hill, 2005.
4. Y.V.C. Rao, “An introduction to thermodynamics”, Universities Press, 2nd edition, 2010
5. Fuel Cell Technologies for Vehicles by Richard Stobart – SAE Hardboud papers.
6. Advanced Vehicle technologies by Heinz Heisler – SAE International Publication.
7. Electric and Hybrid Electric Vehicles by Ronald K. Jurgen – SAE International Publication.

Course Code	Course Title						Core/Elective
PC252ME	**Machine Drawing and Modelling Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To understand format of drawing sheet, angle of projections, isometric projections and practice on simple machine elements
- To practice free hand sketching of machine elements
- To understand Modelling of assembly drawings of typical machine parts.

Course Outcomes

At the end of the course, the student

1. Will be able to draw isometric and orthogonal projections and sectional views of various mechanical components.
2. Will be able to draw free hand sketches of various mechanical components
3. Will be able to understand the shape and structure of different types of joints, screws, keys and Couplings
4. Will be sufficiently knowledgeable to use both the software and drafter to produce assembly views of various mechanical components from part drawings.

List of Experiments:

I. Machine Drawing (AutoCAD):

1. Format of drawing sheet & title block,
2. Conventions of drawing lines and dimensions,
3. Convention for sectional views.
4. Simple machine elements.
5. Riveted and screwed fastenings.
6. Joints and coupling.

II. Assembly drawing (SOLIDWORKS/ CATIA/ PRO-E):

7. Connecting rod.
8. Eccentric.
9. Cross head.
10. Stuffing box.
11. Lathe Tool Post.
12. Revolving centre.
13. Pedestal bearing (Plummer block).
14. Screw Jack.

Note: The test is for the ability of the student to read and interpret drawing. The drawing should include part list in standard format.

Suggested Readings:

1. N.D. Bhatt, Machine Drawing, Charotar Publishing house, Anand, New Delhi, 28th edition, 1994.
2. K.L. Narayana, P. Kannaiah, K. Venkat Reddy, Machine Drawing, New Age International (P) Ltd., 2nd edition 1999.
3. N. Siddeshwar, Machine Drawing, Tata McGraw Hill Publishing Co. Ltd., 5th edition, 1994
4. K. C. John, Text book of Machine Drawing, PHI Learning.

Course Code	Course Title						Core/Elective
PC253AE	**Fluid Power Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

It is intended to make the students

- To gain the knowledge about performance and characteristic curves of pumps and turbines.
- To understand the impact of jets on vanes
- To study hydraulic circuits and pneumatic circuit

Course Outcomes

After completing this course, the student will be able to:

1. To determine work done by fluid jet on vane, compute work done and draw performance characteristic curves for turbines and centrifugal pumps.
2. Evaluate the performance characteristics of pumps.
3. Demonstrate the characteristics curves of turbines.
4. Understand the use of hydraulic and pneumatic circuits.

List of Experiments:

1. Performance and characteristic curves of Self Priming pump
2. Performance and characteristic curves of Centrifugal/ Submergible pump
3. Performance and characteristic curves of Reciprocating pump
4. Performance and characteristic curves of Gear pump
5. Impact of Jets on Vanes
6. Performance and characteristic curves of Pelton Wheel
7. Performance and characteristic curves of Francis Turbine
8. Performance and characteristic curves of Kaplan Turbine
9. Drag and Lift coefficients of airfoil
10. Performance and characteristic curves of Turbo Wheel
11. Study of Hydraulic Circuits
12. Study of pneumatic Circuits

Note: Minimum ten experiments should be conducted in the semester

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Automobile Engineering) IV – SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	MC112CE	Environmental Science	2	-	-	2	30	70	3	-
2	MC113PY	Essence of Indian Traditional Knowledge	2	-	-	2	30	70	3	-
3	HS203MP	Industrial Psychology	3	-	-	3	30	70	3	3
4	BS206BZ	Biology for Engineers	3	-	-	3	30	70	3	3
5	ES213ME	Energy Sciences and Engineering	2	-	-	2	30	70	3	2
6	PC231ME	Mechanics of Materials	3	-	-	3	30	70	3	3
7	PC233ME	Kinematics of Machinery	3	-	-	3	30	70	3	3
8	PC235AE	Automotive Chassis Components	3	-	-	3	30	70	3	3
9	PC236AE	Metallurgy and Material Testing	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
10	PC264AE	Automotive Chassis Components Lab	-	-	2	2	25	50	3	1
11	PC265AE	Metallurgy and Material Testing for Automobile Lab	-	-	2	2	25	50	3	1
			24	**-**	**04**	**28**	**320**	**730**		**22**

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
MC: Mandatory Course PC: Professional Core
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam)
PY: Philosophy, BZ: Biology/ Life Sciences, CE: Civil Engineering
MP: Mechanical / Production Engineering, ME: Mechanical Engineering, AE : Automobile Engineering.

Note:

1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.
3. All the mentioned **Mandatory Courses** should be offered either in I–Semester or II–Semester only **from the academic year 2019-2020**.
4. For those of the students admitted during the academic year 2018-2019, since the Mandatory Courses were not offered during the I–Semester or II–Semester, they should be offered either in III–Semester or IV–Semester of the **academic year 2019-2020.**
5. The students have to undergo a Summer Internship of two-week duration after IV – Semester and credits will be awarded in V - Semester after evaluation.

Course Code	Course Title						Core/Elective
MC112CE	**Environmental Science**						**Mandatory**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**2**	**-**	**-**	**-**	**30**	**70**	**-**

Course Objectives

- To create awareness and impart basic knowledge about the environment and its allied problems.
- To know the functions of ecosystems.
- To understand importance of biological diversity.
- To study different pollutions and their impact on environment.
- To know social and environment related issues and their preventive measures.

Course Outcomes

After completing this course, the student will be able to:

1. Adopt environmental ethics to attain sustainable development.
2. Develop an attitude of concern for the environment.
3. Conservation of natural resources and biological diversity.
4. Creating awareness of Green technologies for nation's security.
5. Imparts awareness for environmental laws and regulations.

UNIT-I

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, need for public awareness.

Natural Resources: Water Resources – Use and over utilization of surface and ground water, flood, drought, conflicts over water, Dams: Benefits and Problems. Food Resources –World Food Problems, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, Forest Resources –Use and over exploitation, deforestation & its effect on tribal people. Land Resources –Land Degradation, environmental effect of mining, man induced landslides, soil erosion and desertification**.** Energy Resources –Growing energy needs, Renewable and Non-renewable energy resources.

UNIT-II

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in ecosystem, food chains, ecological pyramids, ecological succession, types of ecosystems (marine, pond, river, forest, grassland, desert)

UNIT-III

Biodiversity: Levels of Biodiversity, Bio-geographical classification of India, Value of biodiversity, Threats to biodiversity, endangered and endemic species of India, Conservation of biodiversity, global and national efforts.

UNIT-IV

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution, solid waste management.

Environment Protection Act: Air, water, forest and wildlife Acts, issues in the enforcement of environmental legislation.

UNIT-V

Social Issues and the Environment: Watershed management and environmental ethics. Climate change, global warming, acid rain, ozone layer depletion.

Environmental Disaster Management: Types of disasters, impact of disasters on environment, infrastructure, and development. Basic principles of disaster mitigation, disaster management, and methodology. Disaster management cycle and disaster management in India.

Field Work:

- Visit to a local area to document environmental issues- agricultural area/ pond/lake/terrestrial ecosystem
- Visit to a local polluted area- market/slum area/Industrial area/traffic area

Suggested Readings:

1. A.K. De, *Environmental Chemistry*, Wiley Eastern Ltd.
2. E.P. Odum, *Fundamentals of Ecology,* W.B. Sunders Co., USA.
3. M.N. Rao and A.K. Datta, *Waste Water Treatment,* Oxford and IBK Publications.
4. Benny Joseph, *Environmental Studies,* Tata McGraw Hill, 2005.
5. V.K. Sharma, *Disaster Management*, National Centre for Disaster Management, IIPE,1999.

Course Code	Course Title						Core/Elective
MC113PY	**Essence of Indian Traditional Knowledge**						**Mandatory**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**2**	**-**	**-**	**-**	**30**	**70**	**-**

Course Objectives

The course will introduce the students to

- To get a knowledge in Indian Philosophical Foundations.
- To Know Indian Languages and Literature and the fine arts in India & Their Philosophy.
- To explore the Science and Scientists of Medieval and Modern India

Course Outcomes

After successful completion of the course the students will be able to

1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature among difference traditions.
3. Learn the philosophy of ancient, medieval and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.
6. The essence of Yogic Science for Inclusiveness of society.

UNIT – I

Introduction to Indian Philosophy: Basics of Indian Philosophy, culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian culture, Ancient Indian, Medieval India, Modern India.

UNIT – II

Indian Philosophy & Literature: Vedas Upanishads, schools of Vedanta, and other religion Philosophical Literature. Philosophical Ideas the role of Sanskrit, significance of scriptures to current society, Indian Philosophies, literature of south India.

Indian languages and Literature-II: Northern Indian languages & Philosophical & cultural & literature.

UNIT – III

Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT – IV

Indian Fine Arts & Its Philosophy (Art, Technology & Engineering): Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in Indian, development of science in ancient, medieval and modern Indian.

UNIT – V

Education System in India: Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Scientists of Medieval India, Scientists of Modern India. The role Gurukulas in Education System, Value based Education.

Suggested Readings:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition'', ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN-13:978-8187276333,2007
3. NCERT, "Position Paper on Arts, Music, Dance and Theatre'', ISBN 81-7450-494-X, 2006
4. S. Narain, "Examination in Ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M.Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN-13: 978-8120810990,2014
7. Chatterjee. S & Dutta "An Introduction to Indian Philosophy"

Course Code	Course Title						Core/Elective
HS203MP	**Industrial Psychology**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The course will introduce the students to

- To Know Industry Structures and functions.
- Develop an awareness of the major perspectives underlying the field of Industrial Psychology
- Understanding for the potential Industrial Psychology has for society and organizations now and in the future.

Course Outcomes

After completing this course, the student will be able to:

1. Understanding of key concepts, theoretical perspectives, and trends in industrial psychology.
2. Evaluate the problems thorough and systematic competency model.
3. Analyse the problems present in environment and design a job analysis method.
4. Create a better work environment for better performance.
5. Design a performance appraisal process and form for the human behavior.

UNIT-I

Industrial Engineering: Meaning, Definition, Objective, Need, Scope, Evolution and developments. Concept of Industrial Engineering, Historical development of Industrial Engineering, main departments of Industry.

Organization Structure: Introduction, Principles of Organization, Organizational theories, Departmentalism, Authority, power, Organizational effectiveness, structuring the Organization, Organizational change, Organization charts.

UNIT-II

Motivation, Morale and Behavioural Science: Motivation, Characteristics, Kinds of motivation, Thoughts of motivational philosophy, Human needs, Incentive as motivators, Managing Dissatisfaction and frustration, Morale, Absenteeism, Behavioural Science.

Social environment: Group dynamics in Industry Personal psychology, Selection, training, placement, promotion, counselling, job motivations, job satisfaction. Special study of problem of fatigue, boredom and accidents.

UNIT-III

Understanding Consumer Behavior: Consumer behaviour, study of consumer preference, effects of advertising, Industrial morale: The nature and scope of engineering psychology, its application to industry

UNIT-IV

Work Methods: Efficiency at work, the concept of efficiency, the work curve, its characteristics, the work methods; hours of work, nature of work, fatigue and boredom, rest pauses. The personal factors; age abilities, interest, job satisfaction, the working environment, noise, illumination, atmospheric conditions, increasing efficiency at work; improving the work methods, Time and motion study, its contribution and failure resistance to time and motion studies, need for allowances in time and motion study.

UNIT-V

Work and Equipment Design: Criteria in evaluation of job-related factor, job design, human factors, Engineering information, input processes, mediation processes, action processes, methods design, work space and its arrangement, human factors in job design. Accident and Safety: The human and economic costs of accidents, accident record and statistics, the causes of accidents situational and individual factors related to accident reduction.

Suggested Readings:

1. TR Banga and SC Sharma, *Industrial Engineering and Management*, Khanna Publishers, 11th Edn., 2014.
2. Tiffin, J and McCormic E.J., *Industrial Psychology*, Prentice Hall, 6th Edn., 1975.
3. McCormic E.J., *Human Factors Engineering and Design*, McGraw Hill, 4th Edn.,1976.
4. Mair, N.R.F., *Principles of Human relations*
5. Gilmer, *Industrial Psychology*
6. Ghiselli & Brown, *Personnel and Industrial Psychology.*
7. Myer, *Industrial Psychology.*
8. Dunnete, M.D., *Handbook of Industrial and Organizational Psychology.*
9. Blum & Taylor, *Industrial Psychology*

Course Code	Course Title						Core/Elective
BS206BZ	**Biology for Engineers**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

Gain vivid knowledge in the fundamentals and uses of biology, human system and plant system.

Course Outcomes

After completing this course, the student will be able to:

1. Apply biological engineering principles, procedures needed to solve real-world problems.
2. Understand the fundamentals of living things, their classification, cell structure and biochemical constituents.
3. Apply the concept of plant, animal and microbial systems and growth in real life situations.
4. Comprehend genetics and the immune system.
5. Know the cause, symptoms, diagnosis and treatment of common diseases.
6. Apply basic knowledge of the applications of biological systems in relevant industries.

UNIT-I

Introduction to Life: Characteristics of living organisms, Basic classification, cell theory, structure of prokaryotic and eukaryotic cell, Introduction to Biomolecules: definition, general classification and important functions of carbohydrates, lipids, proteins, vitamins and enzymes.

UNIT-II

Biodiversity: Plant System: basic concepts of plant growth, nutrition, photosynthesis and nitrogen fixation. Animal System: Elementary study of digestive, respiratory, circulatory, excretory systems and their functions. Microbial System: History, types of microbes, economic importance and control of microbes.

UNIT-III

Genetics and Evolution: Theories of evolution and Evidences; cell division–mitosis and meiosis; evidence of laws of inheritance; variation and speciation; nucleic acids as a genetic material; central dogma; Mendel laws, gene and chromosomes.

UNIT-IV

Human Diseases: Definition, causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, influenza, AIDS and Hepatitis. Immunity immunization, antigen – antibody immune response.

UNIT-V

Biology and its Industrial Applications: Transgenic plants and animals, stem cell and tissue engineering, bioreactors, bio pharming, recombinant vaccines, cloning, drug discovery, biological neural networks, bioremediation, biofertilizer, biocontrol, biofilters, biosensors, biopolymers, bioenergy, biomaterials, biochips, basic biomedical instrumentation.

Suggested Readings:

1. A Text book of Biotechnology, R.C. Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004
4. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
5. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
6. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012.

Course Code	Course Title						Core/Elective
ES213ME	**Energy Sciences and Engineering**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**2**	**-**	**-**	**-**	**30**	**70**	**2**

Course Objectives

The objectives of this course is to impart knowledge of

- Able to identify various sources of energy.
- Understand the difference between Conventional and renewable energy sources.
- Identify various storage devices of Energy.
- Able to estimate the costing of power plant.

Course Outcomes

After completing this course, the student will be able to:

1. Understand the basics of various sources of energy
2. Analyse the present status of conventional energy sources.
3. Understand the working principles of Renewable Energy systems
4. Design and develop waste heat recovery systems.
5. Relate energy economics, standards and future challenges.

UNIT-I

Introduction: Various sources of energy, relative merits and demerits, Statistics and prospects of conventional and Renewable energy sources.

UNIT-II

Conventional Energy Sources: Fossil Fuels: Power generation using steam turbine and gas turbine power plants, Nuclear Fuels: Parts of reactor core, Nuclear power plant outline, Methods to dispose radioactive waste. Hydro Energy: Spillways, Hydroelectric power plant outline.

UNIT-III

Renewable Energy Systems: Solar Energy – Types of collectors and concentrators, Solar Photo Voltaic Cell. Wind Energy – Types of Wind Turbines and their working, geothermal power plant, Biomass conversion, Wave Energy power plant, Tidal Energy power plant, Ocean thermal energy power plant.

UNIT-IV

Storage: Methods to store Mechanical Energy, Electrical Energy, Chemical Energy and Thermal Energy. Co-generation &Tri-generation: Definition, application, advantages, classification, saving Potential. Energy waste, waste heat recovery classification, advantages and applications, commercially viable waste heat recovery devices.

UNIT-V

Power Plant Economics and Environmental Considerations: Costing, Estimation of power production - Pollutants and Pollution Standards -Methods of pollution control. Energy Efficiency rating and BEE standards, Future energy needs and challenges.

Suggested Readings:

1. Wakil MM, *Power Plant Technology*, McGraw Hill
2. P.K. Nag, *Power Plant Engineering*, McGraw-Hill
3. G.D. Rai, *Non-Conventional Energy Sources*, Khanna Publishers
4. Mili Majumdar, *Energy Efficient Buildings in India*, Ministry of Non-Conventional Energy Sources.

Course Code	Course Title						Core/Elective
PC231ME	**Mechanics of Materials**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand the basic concept of stress and strains for different materials.
- To know the mechanism of the development of shear force and bending moment in beams and the stresses in thin cylinders & spheres.
- To know the theory of simple bending, direct & bending stress and distribution of shear stress.
- To analyse and understand shear stress, torsional stress and spring applications.
- To study the deflections and its applications.

Course Outcomes

1. To understand the theory of elasticity and Hooke's law
2. To analyse beams to determine shear force and bending moments
3. Analyse shear stress distribution in different sections of beams.
4. To analyse and design structural members subjected to combined stresses
5. To solve problems on bars and to determine deflections at any point of the beams

UNIT – I

Simple Stresses & Strains: Types of stresses & strains, Stress-Strain relations (Hooke's law), Relation between elastic constants, Volumetric strain, Composite bars, Temperature stresses. **Strain energy:** Gradual, Sudden, Impact and Shock loading.

Compound Stresses: Stresses on oblique planes, Principal stresses and Principal planes. Mohr's circle and ellipse of stresses & strains.

UNIT – II

Shear Force and Bending Moment: Construction of S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads, Point of contra flexure and Relation between S.F & B.M.

Thin Cylinders & Spheres: Derivation of formulae for longitudinal stress, Circumferential (hoop) stress, Volumetric strains, Changes in diameter and volume.

UNIT – III

Bending stresses in Beams: Assumptions made in pure bending, Derivation of bending moment equation, Modulus of section, Moment of resistance, Determination of bending stresses. Direct and Bending Stresses: Basic concepts, Core of sections for square, rectangular, solid and hollow circular.

Distribution of shear stress: Equation of shear stress, Distribution across rectangular section.

UNIT – IV

Torsion of Circular Shafts: Theory of pure torsion, Assumptions made, Derivation of basic torsion equation, Torsional moment of resistance, Polar section modulus, Power transmitted by shafts, Combined bending and torsion.

Helical Springs: Close and open coiled helical springs subjected to axial loads, axial couples, Strain energy in springs.

UNIT - V

Deflection of Beams: Deflections of cantilever and simply supported beams including overhanging beams for point loads and uniformly distributed loads by Double integration method, Macaulay's method, Strain energy method, Moment area method, Conjugate beam method and Maxwell reciprocal theorem.

Suggested Readings:

1. S. Ramamrutham, Strength of Materials, Dhanpat Rai & Sons, 1993.
2. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Publishers, Delhi, 2000.
3. R.K. Rajput, Strength of Materials, S. Chand & Co., 2003.
4. EgorP.Popov,EngineeringMechanicsofSolids,PrenticeHallofIndia,NewDelhi,2001.
5. Gere & Timoshenko, Mechanics of Materials, 2nd Edition, CBS Publishers and Distributors Pvt. Ltd.
6. Ferdinand P. Beer et.al., Mechanics of Materials, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2005.

Course Code	Course Title						Core/Elective
PC233ME	**Kinematics of Machinery**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The objectives of this course is to impart knowledge of

- Analysis of mechanisms.
- Drawing displacement diagrams for followers with various types of motions.
- Cam profile drawing for various followers.
- Estimation of transmission of power by belts and application of various gears and gear trains.

Course Outcomes

After completing this course, the student will be able to:

1. Understand the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains and planar mechanisms.
2. Analyse the planar mechanisms for position, velocity and acceleration.
3. Design frictional systems like belt drives, rope drives, clutches, bearings and screw threads
4. Design cams and followers for specified motion profiles.
5. Evaluate gear tooth geometry and select appropriate gears for the required applications.

UNIT-I

Definition of link, pair, kinematic chain, mechanism and machine, Kutzbach and Grubler criterion, Grashoff's law, inversions of quadratic cycle chain, inversions of single and double slider crank chains. Fundamentals of coupler curves, Robert's law, Pantograph, Geneva mechanism, Hooke's joint, Davis and Ackerman's Steering gear mechanisms.

Introduction to Type, Number and Dimensional synthesis of four bar planar mechanisms

UNIT-II

Analysis of Mechanisms: Instantaneous centre, body centrode and space centrode, Kennedy's theorem, Graphical methods (relative velocity method, instantaneous center method) to find velocities and accelerations including Coriolis component of acceleration of planar mechanisms. Angular velocity theorem.

UNIT-III

Laws of Friction: Friction in screw threads, pivots, collars and clutches, friction axis of link and friction circle

Belts and Rope drives: Open and closed belt drives, length of belt, ratio of tensions, effect of centrifugal tension and initial tension on power transmission, condition for maximum power transmission

Brakes: Block or shoe brake, internal expanding shoe brake, disc brake, belt brakes

Dynamometers: Rope brake, belt transmission and Torsion type dynamometers

UNIT-IV

Cams: Types of cams and followers, Displacement, velocity, acceleration and jerk (SVAJ) diagrams for follower motion, Analysis of uniform motion, parabolic motion, simple harmonic motion and cycloidal motion profiles. Graphical synthesis of planar cams with knife edge, roller and flat face followers. Eccentric circle cam with translating roller follower.

UNIT-V

Gears: Classification of gears. Spur gears- Nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycloidal tooth profile.

Helical gears: Helical gear tooth relations, contact of helical gear teeth.

Gear trains- Simple, compound, reverted, and epicyclic gear trains.

Suggested Readings:

1. S.S. Rattan, Theory of Machines, Tata McGraw-Hill, 3rd Edition,2009.
2. J. E. Shigley, Theory of Machines and Mechanisms, McGraw-Hill Publications,2005.
3. Thomas Bevan, Theory of Machines, CBS Publishers
4. Norton RL, Kinematics and Dynamics of Machinery, McGraw-Hill Publications
5. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines, East West Press Pvt. Ltd,2008

Course Code	Course Title						Core/Elective
PC235AE	**Automotive Chassis Components**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The student should be able

- To understand the basic concepts of structure and frame of an automobile and discuss the various types of frames used in automobiles along with their constructional details.
- To understand constructional details and working of front axles, steering geometry.
- To understand different types of drives used in automobiles, namely the Hotchkiss drive, Torque tube drive and the final drives, components of transmission and rear axle.
- To understand the components and working of different types of suspension system.
- To understand the components and working of different types of brakes.

Course Outcomes

1. To identify different types of frames and assess how loads act on different cross-sections of frames
2. To demonstrate working of front axles, steering geometry and select the materials required for them.
3. To explain different types of drives used in automobiles, namely the Hotchkiss drive, Torque tube drive and the final drives, components of transmission and rear axle.
4. To explain different types of suspension systems and assess the suitability of a suspension system based on the type of vehicle
5. To explain different types of Braking system and distinguish between them.

UNIT –I

Introduction: Types of chassis layout with reference to power plant locations and drives; vehicle frames, various types of frames, constructional details, materials, testing of vehicle frames, unitized frame body construction.

UNIT –II

Front Axle and Steering System: Types of front axles, construction details, materials, front wheel geometry: caster, camber, king pin inclination, toe0in; Conditions for true rolling motion of wheels during steering; steering geometry, Davis steering system and Ackerman, constructional details of steering linkages, different types of steering gear boxes, steering linkages and layouts, turning radius, wheel wobble, power assisted steering, steering of crawler tractors.

UNIT -III

Drive Line: Effect of driving thrust and torque reactions, Hotchkiss drive, torque tube drive and radius rods, propeller shaft, universal joints, front wheel drive, different types of final drive, double reduction and twin speed final drives, differential principle, construction details of differential unit. Non-slip differential, differential locks, differential housings, construction of rear axles, types of loads acting on rear axles, fully floating, three quarter floating and semi floating rear axles, rear axle housing, construction of different types of axle housings, multi axle vehicles.

UNIT –IV

Suspension System: Need of suspension system, types of suspension, suspension springs, construction details and characteristics of leaf spring, coil spring and torsion bar springs; Independent suspension, rubber suspension, pneumatic suspension and shock absorbers.

UNIT –V

Braking System: Classification of brakes, drum brakes and disc brakes, constructional details, theory of braking, concept of dual brake system, parking brake, hydraulic system, vacuum assisted system, air brake system, antilock braking system, retarded engine brakes, eddy retarders.

Suggested Readings:

1. Kirpal Singh "Automobile Engineering- vol-1" Standard publishers, 2007.
2. R.B Gupta "Automobile Engineering- vol-1" Tech India, 2007.
3. K.K. Ramalingam "Automobile Engineering" Scitech publication, 2001.
4. Joseph Heitner "Automobile Mechanics", CBS Publishers, 2nd edition.
5. Crouse/ Anglin "Automotive Mechanics" Tata Mc Graw Hill, 9th edition.

Course Code	Course Title						Core/Elective
PC236AE	**Metallurgy and Material Testing**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand imperfections and dislocations in crystals, Types of fractures in metals, hot and cold working processes.
- To understand fatigue, creep and diffusion.
- To understand the structure of alloys, structure and characteristics of plain carbon steels and cast irons.
- To understand different methods of heat treatment.
- To understand materials used for automobiles

Course Outcomes

1. Identify the defects in metals and differentiate hot working and cold working, recovery, recrystallization and grain growth.
2. To analyse fatigue crack propagation, effect of metallurgical variables, creep deformation mechanism apply diffusion theory.
3. Construct and interpret the phase equilibrium diagrams and Iron-Iron carbide equilibrium diagram
4. Explain the behavior of materials upon heat treatment, construct and interpret TTT diagram and appreciate the importance of case hardening
5. Describe various metallic and non-metallic materials and select them for automobiles.

UNIT-I

Imperfections in crystals, Dislocations in crystals, Types of dislocations, Critical resolved shear stress, Effect of slip and twinning on the plastic deformation, Jogs and its effect on yield phenomenon, Hall-Petch equation, Ornge Pell effect, cold and hot working, strain hardening and Bauchinger effect, recovery, Recrystallization, Grain growth and its effect on mechanical properties of metals.

Fracture: Types of fracture in metals, modes of fracture, Griffith theory of brittle fracture, Crack propagation, ductile fracture, Fracture under combined stress.

UNIT-II

Fatigue: S-N curve, Structure of fatigue fracture specimen. Fatigue crack propagation, effect of metallurgical variables on fatigue of metal, low cycle fatigue, cumulative fatigue and fatigue damage, Experimental determination of fatigue strength (RR-Moore Test), Factors to be considered for the improvement of the fatigue life.

Creep: Creep strength, creep curve, creep deformation mechanisms, creep test, differences between creep curve and stress rupture curve.

Diffusion: Fick's law of diffusion, application of diffusion theory in mechanical engineering.

UNIT-III

Structure of Alloys: Construction and interpretation of thermal equilibrium diagram of binary nonferrous alloys, study of eutectic, eutectoid, peritectic, peritectoid reactions. Iron-Iron Carbide Equilibrium diagram, construction and interpretation. Types of plain carbon steels, cast iron and their properties and characteristics.

UNIT-IV

Heat Treatment: Annealing, Normalising, Hardening, Tempering, Construction and interpretation of T.T.T Curve. Austempering and Martempering.

Case Hardening: Carburising, Nitriding, Carbo-nitriding, Flame Hardening and Induction Hardening. Brief introduction of Age hardening.

UNIT-V

Selection of materials: Criteria of selecting materials for automotive components viz Cylinder block, Cylinder head, Piston, Piston ring, Gudgeon pin, Connecting rod, Crank shaft, Crank case, Cam, Cam shaft, Engine valve, Gear wheel, Clutch plate, Axle bearings, Chassis, Spring, body panel radiator, brake lining etc. Application of non-metallic materials such as composite, ceramic and polymers in automobile.

Testing of materials: Universal testing machine-tension, compression, bending and shear tests, Hardness testing- Rockwell, Brinnell's and Vicker's diamond methods. Toughness measurement- Izod and Charpy methods, Torsion test.

Non-Destructive Testing methods: Ultrasonic testing, Magnetic Particle Testing, Liquid penetrant testing, Radiographic testing, Eddy Current Testing, Visual Testing and Thermal/Infra-Red Testing.

Suggested Readings:

1. V. Raghavan, Material Science and Engineering, Prentice Hall of India Ltd., 4th edition. 1994
2. S.H. Avner, Introduction to physical metallurgy, Tata Mc Graw Hill, 2nd edition. 1997
3. S.P Nayak, Engineering Metallurgy and Material Science, Charotar publishing House, 6th edition. 1995
4. E. Dieter, Mechanical Metallurgy, Metric Edition. Tata Mc Graw Hill, 3nd edition. 1997
5. Serope kalpakjain and Steven R- Schmid, Manufacturing Engineering & Technology, Pearson, 4th edition. 2006.
6. Khanna.O.P. Material Science and Metallurgy, Dhanpat Rai & Sons, 1992.
7. Kapoor, Material Science and Processes, New India Publishing House, 1987.

Course Code	Course Title						Core/Elective
PC264AE	**Automotive Chassis Components Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

It is intended to make the students to

- Know the constructional details of automobile frame, front & rear axles
- Work on different types of clutches, differential, gear boxes, brakes, suspension systems used in automobiles along with their components
- Assembling and disassembling of clutches, front axle, rear axle, steering, braking, suspension systems and differential gear box.

Course Outcomes

After completing this course, the student will be able to:

1. Identify the different automotive components.
2. To identify, assemble and dissemble different types of Braking system and distinguish between them.
3. To identify, assemble and dissemble different types of suspension systems.
4. To demonstrate working of steering, front axles and rear axles.
5. To demonstrate working of the clutches, suspension systems and differential gear box.

List of Experiments:

Study and measurement of following chassis frames:

1. Light Motor Vehicle frame
2. Heavy Duty Vehicle frame

Study, Disassembling and Assembling:

3. Front Axle
4. Rear Axle
5. Differential
6. Steering Systems along with any two types of steering gear box
7. Braking Systems: Hydraulic, Servo Vacuum, compressed air power brakes
8. Leaf Spring, coil spring, torsion bar spring, hydraulic shock absorber
9. Assembly of different types of clutches
10. Gear Box
11. Transfer Case

Course Code	Course Title						Core/Elective
PC265AE	**Metallurgy and Material Testing for Automobile Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

It is intended to make the students

- To know and understand the experiments on various materials to assess their behavior / limitations.
- To understand the Shear force, bending moment and deflections of different types of beams.
- To know the structure of Ferrous and Non-Ferrous materials, properties and their practical applications.
- To understand the heat treatment process of steel

Course Outcomes

1. Prepare specimen for metallographic observation
2. Analyse and identify low, medium and high carbon steels, different types of cast irons, non-ferrous alloys, from the study of their microstructure
3. Underlines the importance of grain size in evaluating the desired mechanical properties.
4. Correlate the heat treatment methods and the mechanical properties obtained.
5. Analyse and identify microstructures after annealing, normalizing, hardening and tempering Relate the properties of the materials using image analyser

List of Experiments:

1. Direct tension test on plain carbon steels
2. Young's modulus of metal specimen by direct tension test
3. Brinell's and Rockwell's hardness test
4. Compression test
5. Torsion test to determine the rigidity modulus of a shaft
6. Fatigue test
7. Procedure of metallurgical specimen preparation
8. Study of metallurgical microscope
9. Study of Iron-Iron Carbon diagram
10. Metallographic study and analysis of plain carbon steels, cast iron, non-ferrous alloys like: brass, bronze, Al—Si alloys.
11. Demonstration of heat treatment process
12. Study of microstructure after hardening, normalizing and annealing of steel specimen.

Note: minimum ten experiments should be conducted in the semester