FACULTY OF ENGINEERING

Scheme of Instruction & Examination

and

Syllabi

B.E. V and VI Semesters

of

Four Year Degree Programme

in

AUTOMOBILE ENGINEERING

(With effect from the Academic Year 2018 – 2019)
(As approved in the Faculty Meeting held on 26th June 2018)

Issued by

Dean, Faculty of Engineering
Osmania University, Hyderabad-500 007
2018

SCHEME OF INSTRUCTION & EXAMINATION
B.E. V - Semester
(AUTOMOBILE ENGINEERING)

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 Course										
1	PC501AE	Automotive Diesel Engines	3	-	-	3	30	70	3	3
2	PC502AE	Automotive Transmission	3	-	-	3	30	70	3	3
3	PC503AE	Design of Machine Components	4	-	-	4	30	70	3	4
4	PC501ME	Dynamics of Machines	4	-	-	4	30	70	3	4
5	PC504ME	Heat Transfer	3	1	-	4	30	70	3	3
6	PC505ME	Operations Research	3	-	-	3	30	70	3	3
7	MC901EG	Gender Sensitization	3	-	-	3	30	70	3	0
Practical/ Laboratory Course										
7	PC551AE	Automotive Engineering Lab	-	-	2	2	25	50	3	1
8	PC552AE	Fuels, Lubricants & Engine Testing Lab	-	-	2	2	25	50	3	1
9	PC553ME	Dynamics Lab	-	-	2	2	25	50	3	1
Total			**23**	**1**	**6**	**30**	**285**	**640**	**-**	**23**

PC: Professional Course **PE**: Professional Elective
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

Course code	Course Title						Core/Elective
PC501AE	**AUTOMOTIVE DIESEL ENGINES**						**Core**
Prerequisite	**Contact hours per week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To impart the basic concepts of CI Engine and Combustion
- To know about CI engine emissions and their treatments
- To differentiate ideal and actual cycles
- To understand Fuel injection systems in CI engines
- To know about Super charging and Turbo charging

Course Outcomes:

The student is able to

- Understand the basic principle of operation of diesel engine and its subsystems
- Differentiate, analyze ideal and actual cycles
- Apply their knowledge in operating the diesel engine and analyzing the engine performance characteristics.
- Diagnose Fuel injection systems in CI engines

UNIT – I

Basic Theory: Diesel engine construction and operation, two stroke and four stroke diesel dual cycle engines, diesel cycle, fuel-air and actual cycle analysis, diesel fuel, ignition quality, Cetane number, laboratory tests for diesel fuels, standards and specifications.

UNIT – II

Fuel Injection System: Requirements of fuel injection, functions of components, jerk and distributor type pumps common rail system, PTFI system pressure waves, injection lag, unit injector, mechanical and pneumatic governors, fuel injector, types of injection nozzles, nozzle tests, spray characteristics, injection timing, pump calibration.

UNIT – III

Air Motion, Combustion and Combustion Chambers: Importance of air motion, swirl, squish and turbulence, swirl ratio, fuel air mixing, stages of combustion, delay period, factors affecting delay period, knock in CI engines. Comparison of knock in CI & SI engines. Combustion chamber: design requirements, direct and indirect injection combustion chambers. Air cell chamber. M type combustion chamber. Combustion chambers for HCCI engines. Pressure-Crank angle diagram, combustion phenomenon in C.I. Engines. Concepts of burning rate and flame velocity, Fuel spray characteristics and combustion in diesel engines.

UNIT – IV

Supercharging and Turbocharging: Necessity and importance of Supercharger / Turbocharger. Limitations, Effect of Supercharging / Turbo charging on power output & efficiency of engine. Methods of supercharging / Turbo charging, design of Turbo charger Variable Geometrical Techniques, types of supercharging and turbo charging, relative merits, matching of turbocharger, exhaust gas recirculation, charge cooling & Lubrication. Modification of engine for supercharging.

UNIT – V

Diesel Engine Testing and Performance: Automotive and stationary diesel engine testing and related emission standards. Engine performance and emission characteristics, variables affecting engine

performance and emission, methods to improve engine performance, heat balance, performance maps. Introduction to Stratified charge engine, LHR engines, HCCI and RCCI engines, Problems.

Suggested Reading

1. Ganesan. "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. M.L.Mathur and R. P.Sharma "A course in Internal Combustion Engines", Dhanpat Rai and Sons, 2002.
3. Dr.K.K.Ramalingam "Internal Combustion Engines Theory and Practice", Scitech Publications (India), Pvt. Ltd., Chennai 600 017, 2002.
4. Heywood.J.B "Internal Combustion Engine Fundamentals", McGraw-Hill Book Co., 1988.
5. Pulkrabek "Engineering Fundamentals of the Internal Combustion Engines", Practice Hall of India, 2003.

Course code	Course Title						Core/Elective
PC502AE	**AUTOMOTIVE TRANSMISSION**						**Core**
Prerequisite	**Contact hours per week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To impart basic knowledge in automotive transmission.
- To understand the construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devices and automatic transmission system.
- To understand the concepts of electric drive used in road vehicles.
- To know about mechanical and automatic transmission systems and their applications.

Course Outcomes:

The student is able to

- Explain different types of drive line positions.
- Explain the working principle of Clutches and Gearboxes.
- Realize automotive transmission concepts like hydrodynamic transmission, different drive systems like hydrostatic drives, electrical drives
- Apply automotive transmission concepts in modern vehicles

UNIT-I

Clutch: Requirement of transmission system, Types of transmission system, Clutches- Functions-Types of clutches, construction and operation of Single plate clutch, multi plate clutch, Cone clutch, Centrifugal clutch & Semi centrifugal clutch.

UNIT-II

Gear Box: Objective and need for a gear box in an automobile, method of calculation of gear ratios for vehicles, performance characteristics in different speeds, Construction and Working principle of different types of gear boxes- sliding, constant and synchromesh gear boxes, Spur and internal gear type planetary gearboxes, Ford T-model, Cotal and Wilson Gear box, determination of gear ratios, automatic overdrives, speed synchronizing devices, gear materials, lubrication**.**

UNIT-III

Hydrodynamic Transmission Fluid Coupling: Fluid coupling- principles-performance characteristics-advantages and limitations, construction details, torque capacity, slip in fluid coupling, performance characteristics. Means used to reduce drag torque in fluid coupling.

Torque Converter

Principal of torque conversion, single, multi stage and poly phase torque converters, Automobile Torque Converter Arrangements, performance characteristics, constructional and operational details of typical hydraulic transmission drives (e.g.) Leyland, White Hydro torque drives.

UNIT-IV

Automatic Transmission: Relative merits and demerits when compared to conventional transmission, automatic control of gears, study of typical automatic transmissions, Ford and Chevrolet drive, and automatic control of gear box. Continuously Variable Transmission (CVT)-types-Operations.

UNIT-V

Hydrostatic Drives: Hydrostatic drive-various types of hydrostatic transmission-principle-advantages and disadvantages, principles of hydrostatic drive systems, construction and working of typical hydrostatic drives, Janny Hydrostatic drive.

Electrical Drives: Advantages and limitations, principles of Ward Leonard system of control, Modern electric drive for buses and performance characteristics.

Suggested Reading

1. Heldt P.M – "Torque converters"- Chilton Book Co.-1992.
2. Newton and Steeds – "Motor Vehicle"- Illiffee Publisher- 2000
3. "Design Practices, Passenger Car Automotive Transmissions"- SAE Hand book- 1994
4. K.M. Gupta," Automobile Engineering",, Volume 1, Umesh Publications, 2001
5. Crouse & Anglin, "Automotive Mechanics" McGraw hill, 10th edition.

Course code	Course Title						Core/Elective
PC503AE	**DESIGN OF MACHINE COMPONENTS**						**Core**
Prerequisite	**Contact hours per week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
Strength of Materials	**4**	**-**	**-**	**-**	**30**	**70**	**4**

Course Objectives:

- To know the mechanical properties of materials used in mechanical systems; Component manufacturing consideration; stresses in different types of loading,
- To understand the significance of theories of failure for safe design; fatigue-factors affecting and design for fatigue. S-N diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue – Miner's rule
- To understand the design principles for various load conditions for the design of components such as Shafts- solid, hollow and splined; Standard types of couplings
- To understand the design principles for various load conditions for the design of joints, joining members like bolts, weldments and rivets; Power transmission – pulleys, chains
- To understand the use of above principles for various load conditions for the design of power screws differential and Compound Screws. Design of riveted and welded joints under direct and eccentric loads

Course Outcomes:

- Formulate and analyze stresses and strains in machine elements and structures in 3-D subjected to various loads. Apply multidimensional static failure criteria in the analysis and design of mechanical components.
- Gain knowledge of fatigue failure and load-life relation
- Analyze and design power transmission shafts carrying various elements with geometrical features. Design and analyze shafts with different geometrical features under various loading conditions. Calculate critical speed of shafts and make the design decisions accordingly.
- Design and analyze detachable joints (bolts, keys, pins, etc.) under various loading conditions.
- Design machine elements like power screws and screw jack considering: allowable load, materials, mode of failure, operating conditions and required life. Stresses in power screw. Design procedure of a power screw, differential and compound screws

UNIT-I

Design considerations of Machine Elements: Materials used in machine design and their specifications according to Indian Standards. Codes and standards used in design. Important mechanical properties of materials used in design. Preferred numbers. Manufacturing considerations in design. Review of types of loads and simple stresses. Stresses due to Biaxial and Triaxal loads. Factor of safety. Theories of failure. Design of components subjected to impact loading.

UNIT-II

Design for Fatigue: Fluctuating stresses, fatigue strength and endurance limit, Stress concentration factor and Notch sensitivity. Factor effecting fatigue strength S-N diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue – Miner's rule.

UNIT-III

Design of shafts: Solid, hallow and splined shafts under torsion and bending loads. Design of keys.
Design of couplings: Muff, Split muff, Flange, Flexible, Marine type couplings and slip couplings.

UNIT-IV

Design of Joints: Cotter and Knuckle joints. Design of pulleys. Design of chains drives linked and laminated chains. Design of bolts and nuts, Locking devices for nuts, Bolts of uniform strength. Bolted joints under eccentric loads. Design of gasket joints

UNIT-V

Design of Power Screws and Screw Jack: Differential and Compound Screws. Design of riveted and welded joints under direct and eccentric loads.

Suggested Reading

1. M.F. Spotts, "Design of Machine Elements", Pearson Edu, 7th Ed. 2003.
2. V.B. Bhandari, "Machine Design", Tata McGraw – Hill Publ, 2004.
3. P.C. Sharma & D.K. Aggarwal, "Machine Design", S.K. Kataria & Sons, 10th ed, 2003.
4. P. Kannaiah, "Machine Design", Scu-Tech Publ., 2003
5. J.E.. Shigley & Charles R. Mischke, "Mechanical Engineering Design", Tata McGraw-Hill, 6th ed., 2003.

Course code	Course Title						Core/Elective
PC 501 ME	**DYNAMICS OF MACHINES**						**Core**
Prerequisite	**Contact hours per week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
Kinematics of Machines	**4**	**-**	**-**	**-**	**30**	**70**	**4**

Course Objectives:

- To find static and dynamic forces on planar mechanisms.
- To know the causes and effects of unbalanced forces in machine members.
- To determine natural frequencies of undamped, damped and forced vibrating systems of one, two and multi degree freedom systems.

Course Outcomes:

- Understand various methods of static and dynamic analysis of planar and spatial mechanisms
- Understand and apply the gyroscopic effects in ships, aero planes and road vehicles.
- Analyze balancing problems in rotating and reciprocating machinery
- Apply the concepts of free and forced vibrations of single degree freedom systems in real time systems
- Analyze and design various types of governors like Watt, Porter, Proell, Hartnell governors

UNIT-I

Static and Dynamic: Force analysis of 4-bar and slider crank mechanisms. Study of dynamically equivalent system, Inertia forces on connecting rod. Gyroscope: Gyroscopic couple, gyroscopic effects in vehicles.

UNIT-II

Governors: Classification of governors, Watt, Porter, Hartnell and Hartung governors, Controlling Force, Stability, Isochronism, Sensitivity, Power and Effort of governors.

Flywheels: Functions, Differences between flywheel and governor. Turning moment diagrams, flywheel analysis for I.C. Engines and Presses.

UNIT-III

Balancing: Forces: Forces on bearings due to rotating shaft carrying several masses in several planes. Determination of balance masses from the forces on the bearings, Shaking forces in single cylinder engine, Partial balancing of reciprocating engine. Balancing of two cylinder locomotive engine. Balancing of multi cylinder in-line engines. Balancing of radial engines by direct and reverse cranks method.

UNIT-IV

Vibrations: Vibrations of Single degree freedom system (axial, transverse and torsional). Equivalent system of combination of springs, stepped shaft, whirling speed of shafts. Damped vibrations: Types of damping, Vibrations with viscous damping. Forced vibrations: Vibrations with harmonically applied force with viscous damping. Dynamic magnifier, Resonance, Vibration isolation and Transmissibility.

UNIT-V

Torsional vibrations of two rotor, three rotor and geared systems. Natural frequencies of two degree freedom systems. Modes of vibration. Approximate methods for determining natural frequencies: Dunkerley's method, Rayleigh's method and Holzer's method for multi rotor system.

Suggested Reading:

1. S.S. Rattan, "Theory of Machines", Tata McGraw Hill, Tata McGraw Education Pvt. Ltd., New Delhi 2010.
2. Thomas Bevan, "The Theory of Machines", CBS Publishers & Distributors, 2004.
3. John J. Uicker, Jr., Gordon R. Pennock, Joseph E. Shigley, "Theory of Machines and Mechanisms", Oxford University Press, 2003.
4. J.S. Rao and Gupta, "Theory and Practice of Mechanical Vibrations", Prentice Hall, 1984.
5. R.L. Norten, “Kinematics and Dynamics of Machinery” Tata McGraw Education Pvt. Ltd., New Delhi 2009.

Course code	Course Title						Core/Elective
PC 504 ME	**HEAT TRANSFER**						**Core**
Prerequisite	**Contact hours per week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
Thermodynamics	**3**	**1**	**-**	**-**	**30**	**70**	**3**

Note: During examination, charts necessary for solving problems on unsteady conduction (Heisler charts), heat exchanger charts, tables giving properties of air and water will be supplied.

Course Objectives:

- To understand the basic concepts of heat transfer.
- To study the concepts of conduction, convection, radiation and heat exchangers applicable for commercial and industrial use.
- To study and solve problems on different modes of heat transfer which are related to thermal power plants, refrigeration and air conditioning.

Course Objectives:

- To formulate heat conduction problems in rectangular, cylindrical and spherical coordinate system by transforming the physical system into a mathematical model.
- Familiarize with time dependent heat transfer and compute convective heat transfer coefficients in forced, natural convection.
- To understand radiation heat transfer, heat exchangers and mechanism involved in boiling and condensation.

Unit-I

Basic modes of heat transfer: basic laws of heat transfer, Fourier's law, Newton's law of cooling, Stefen Boltzmann's law of thermal radiation. **Conduction :** general conduction equation on Cartesian, & Cylindrical coordinates. **One dimensional steady state conduction** through slabs, hollow cylinders and spheres with and without heat generation. Effect of variable thermal conductivity in heat transfer for one dimensional steady state conduction in plates. Steady state heat transfer through composite plates, cylinders and spheres. Critical radius of insulation.

Two dimensional steady state heat transfer in a plate with prescribed temperatures at the boundary.

Unit-II

Fins: Heat transfer analysis of a body with negligible internal temperature gradients.

Unsteady state conduction: Lumped parameter analysis of a body with negligible internal temperature gradients. Transient heat transfer analysis of an infinite slab with specified temperature and connective boundary conditions. Use of Grover &Heisler charts for solving problems of infinite slabs, cylinders, spheres.

Unit-III

Convection: Buckingham theorem and use of dimensional analysis in free and forced convection, Physical significance of different dimensionless numbers.

Concept of hydrodynamic and thermal boundary layers. Reynlod's analogy for turbulent flow over flat surfaces. Mixing cup temperature in pipe flows Calculation of heat transfer for flow over plates, cylinders and in pipes in free and forced convection using empirical formulae

Unit-IV

Radiation: Absorptivity, reflectivity and transmitivity definitions. Concept of a blackbody and emissivity. Kirchoff's law. Lambert's cosine law, Plank and Wein's laws Stefen-Boltzmann's Law. Monochromatic and total emissive power hemispherical emissive power Radiant exchange power. Radiant exchange between two grey surfaces Shape factors. Radiant exchange between two infinite parallel plates and between concentric cylinders Radiation shields.

Unit-V

Heat Exchangers: Classification and applications of heat exchangers in industry. Analysis and design of counter flow and parallel flow heat exchangers (shell and tube type) and condensers. Solving problems for multipass heat exchangers using non dimensional parameter plots

Change of Phase

Boiling: Pool boiling regimes, nucleate pool boiling. Condensation: Film condensation, drop wise condensation. Nusselt's analysis to determine condensate film thickness and heat transfer coefficient in film condensation.

Suggested Reading:

1. J.P. Holman, "Heat Transfer", McGraw Hill Book Company, 1986.
2. S.C. Arora and S. Domkundwar, "A course in Heat and Mass Transfer", Dhanpatrai& Sons, New Delhi, 2000.
3. D.S. Kumar, "Heat and Mass Transfer", S.K. Kataria& Sons, New Delhi.
4. Frank. P. Incropera& David P. Dewitt, "Fundamentals of Heat & Mass Transfer", John willey& Sons, 1990.

Course Code	Course Title						Core / Elective
PC 505 ME	**OPERATIONS RESEARCH**						**Core**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**3**	**--**	**--**	**--**	**30**	**70**	**3**

Course Objectives:

- To familiarize with basics of OR, including mathematical modelling, feasible solutions, optimization and iterative computations.
- To understand algorithms to solve different types of transportation models.
- To construct network models and solve using CPM & PERT techniques.
- To model queuing problems, understand probability distributions.

Course Outcomes:

- To understand the resource management and operations in the market
- To efficiently use market materials, time, and money for optimal operations

UNIT-I

Introduction: Definition and Scope of Operations Research.

Linear Programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method, maximization and minimization, Degeneracy in LPP, Unbounded and, Infeaseable solutions.

UNIT-II

Duality : Definition, Relationship between primal and dual solutions, Economic Interpretation, Post optimal of sensitivity analysis, Dual Simplex Method.

UNIT-III

Transportation Models : Finding an initial feasible solution - North West corner method, Least cost method, Vogel's Approximation method, Finding the optimal solution, optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem.

Assignment Problems : Hungarian method of Assignment problem, Maximization in Assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems.

Replacement Models : Introduction, replacement of items that deteriorate igoring change in money value, replacement of items that deteriorate considering change in money value with time, replacement of items that fail suddenly - Individual replacement policy, Group replacement policy.

Game Theory: Introduction, 2 person zero sum games, Maximi - Minimax principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for 2 x n and m x 2 games.

UNIT-V

Sequencing Models: Introduction, General assumptions, processing n jobs through 2 machines, processing 'n' jobs through m machines, Processing 2 jobs through m machines

Queuing Theory: Introduction, single channel - poission arrivals - exponential service times with infinite population & finite population, Multi channel - poisson arrivals - Exponential service times with infinite population.

Introduction to optimization Techniques: Single objective & Multi objective optimization Techniques like G.A, NSGA and P.Q.O. & MPSO Techniques.

Suggested Reading:

1. Hamdy, A. Taha," Operations Research-An Introduction", Sixth Edition, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut, 2009.
3. Harvey M. Wagner, "Principles of Operations Research", 2nd Ed., Prentice Hall of India Ltd., 1980.
4. V.K. Kapoor, "Operations Research" , S. Chand Publishers,New Delhi, 2004.
5. R. Paneer Selvam, "Operations Research" , 2nd Ed. PHI Learning Pvt. Ltd., New Delhi, 2008.
6. Data Reconciliation by Prof. Shanker Narasimha.

Course Code	Course Title						Core / Elective
MC901EG	**GENDER SENSITISATION**						**Core**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**3**	**--**	**--**	**--**	**30**	**70**	**0**

Course Objectives:

- To develop students' sensibility with regard to issues of gender in contemporary India
- To provide a critical perspective on the socialization of men and women
- To introduce students to information about some key biological aspects of genders.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women

Course Outcomes:

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life

UNIT-I

Understanding Gender

Why Should We Study It? Socialization: Making Women, Making Men:

Introduction-Preparing for Womanhood-Growing up male-First lessons in caste-Different Masculinities; **Just Relationships: Being Together as Equals:** Mary Kom and Onler- Love and acid just do not mix-Love Letters-Mothers and Fathers-Further reading: Rosa Parks-The brave heart.

UNIT-II

Gender and Biology

Missing Women: Sex Selection and Its Consequences - Declining sex ratio-.Demographic Consequences; **Gender Spectrum: Beyond the Binary -** Two or many? - Struggles with discrimination; **Our Bodies, Our Health.**

UNIT-III

Gender and Labour

Housework: the Invisible Labour: "My mother doesn't work"- "Share the Load"; **Women's Work: Its Politics and Economics:** Fact and fiction-Unrecognized and unaccounted work- Wages and conditions of work.

UNIT-IV

Issues of Violence

Sexual Harassment: Say No! : Sexual harassment- not eve-teasing- Coping with everyday harassment- "Chupulu"; **Domestic Violence: Speaking Out:** Is home a safe place? When women unite-Rebuilding lives- New forums for justice; **thinking about Sexual Violence:** Blaming the victim-"I fought for my life." The caste face of violence.

UNIT-V

Gender Studies

Knowledge- Through the Lens of Gender - Point of view- Gender and the structure of knowledge-Unacknowledged women artists of Telangana; **who's History? Questions for Historians and Others:** Reclaiming a past- Writing other histories- Missing pages from modern Telangana history.

Suggested Reading

1. A.Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, GoguShyamala, Deepa Sreenivas and Susie Tharu, "Towards a World of Equals: A Bilingual Textbook on Gender*"* Telugu Akademi, Hyderabad, 1st Edition, 2015.
2. www.halfthesky.cgg.gov.in

Course Code	Course Title						Core / Elective
PC 551 AE	**AUTOMOTIVE ENGINEERING LAB**						**Core**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**--**	**--**	**--**	**2**	**25**	**50**	**1**

Course Objectives:

- To understand the special tools used in the lab.
- To understand the different components of the engine and its functions.
- To make the students how to assemble and dissemble the parts of engine components like piston, connecting rod, crank shaft, timing gear, timing chain, cylinder head assembly, lubrication system and cooling system.
- To understand working of cooling system, lubrication system, ignition system and SI engine fuel system.
- To measure the Ovality and taper of cylinder bore and crankshaft Run out.

Course outcomes

- To understand the functionality of different IC engines
- To realise the trouble shooting of different systems of an automotive

List of Experiments

1. Disassembling of 4 cylinder petrol engine
2. Assembling of 4 cylinder petrol engine
3. Disassembling of 6 cylinder diesel engine
4. Assembling of 6 cylinder diesel engine
5. Study of oil filter, fuel filter, fuel injection system, carburetor, MPFI
6. Study of ignition system components – coil, magneto and electronic ignition systems
7. Study of engine cooling system components
8. Study of engine lubrication system components
9. Ovality and taper measurement of cylinder bore and comparison with standard specifications
10. Ovality and taper measurement of engine crank shaft and comparison with standard specification

Suggested Reading

1. Ganesan. V “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co., New Delhi, 2003
2. M.L.Mathur and R.P.sharma “A course in Internal Combustion Engines”, DhanpatRai and Sons, 2002
3. Dr.K K. Ramalingam “Internal Combustion Engines Theory and Practice”, Scitech publications (India) Pnt. Ltd., Chennai 600 017, 2002

Note: Minimum ten experiments should be conducted in the semester

Course Code	Course Title						Core / Elective
PC 552 AE	**FUELS, LUBRICANTS & ENGINE TESTING LAB**						**Core**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**--**	**--**	**--**	**2**	**25**	**50**	**1**

Course objectives:

- To evaluate the properties of fuels and lubricants
- To know the actual Valve Timing and Port Timing Diagrams
- To understand the performance of SI and CI engines
- To prepare Heat Balance Sheet for SI and CI engines

Course Outcome

- Identification of physical and chemical properties of different fuels
- To identify different lubricants and their applications

List of Experiments

1. Temperature dependence of viscosity of lubrication oil by Redwood Viscometer.
2. Viscosity index of lubricating oil by Saybolt Viscometer.
3. Flash and Fire points of fuels.
4. Flash and Fire points of lubricants.
5. Valve Timing and Port Timing Diagrams.
6. Performance test on two wheeler SI engine.
7. Performance test on automotive multi-cylinder SI engine.
8. Performance test on automotive multi-cylinder CI engine.
9. Retardation test on I.C. Engine.
10. Heat Balance test on automotive multi-cylinder SI engine.
11. Heat Balance test on automotive multi-cylinder CI engine.
12. Morse test on multi-cylinder SI engine.

Note: Minimum ten experiments should be conducted in the semester.

Course Code	Course Title						Core / Elective
PC 553 ME	DYNAMICS LAB						Core
	Contact hours per week				CIE	SEE	Credits
Prerequisite	L	T	D	P			
-	--	--	--	2	25	50	1

Course Objectives:

- To understand the effects and importance of kinematic and dynamic analysis of mechanisms
- To understand effects and analysis of Single degree freedom vibration systems
- To study the gyroscope, governors and cams
- To carry out the static and dynamic analysis of four bar mechanisms and drives

Course Outcomes:

- To find out natural frequencies of various beams with different constraints
- Evaluate static and dynamic balancing of masses
- To find the gyroscopic effect on vehicles
- To find out kinematic and dynamic behavior of mechanisms

List of Experiments

Study experiment on:

1. Free vibration of Cantilever Beam
2. Free vibration of Simply Supported Beam
3. Free/ Forced vibrations of a SDOF systemto find Moment of Inertia of a connecting rod
4. Modal analysis of a composite beam
5. Modal analysis of a disc
6. Balancing of Rotors
7. Centrifugal governors
8. Mechanical gyroscope
9. Static & Dynamic Balancing m/c
10. Study experiment on cam analysis

MSC ADAMS SOFTWARE

Simulation of kinematic and dynamic analysis of:

11. Grashoff 4 bar mechanism
12. Non Grashoff 4 bar mechanism
13. Slider crank mechanism
14. Double slider mechanisms
15. Gear (spur, helical, bevel) systems
16. Pulley, rope and chain systems
17. Cam drive systems.

*** DOM LAB - To be changed as per MECHANICAL Department Syllabus.

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VI - Semester
(AUTOMOBILE ENGINEERING)

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 Course										
1.	PC601AE	Design of Automotive Components	4	-	-	4	30	70	3	4
2.	PC602 AE	Performance & Testing of Automotive Vehicles	3	-	-	3	30	70	3	3
3.	PC603 AE	Computer Aided Design, Analysis & Manufacturing	4	-	-	4	30	70	3	4
4.	PC604 AE	Production Technology	3	-	-	3	30	70	3	3
5.	PE-1	Professional Elective-I	3	-	-	3	30	70	3	3
6.	OE-1	Open Elective-I	3	-	-	3	30	70	3	3
Practical/ Laboratory Course										
7.	PC651 AE	Production Technology Lab	-	-	2	2	25	50	3	1
8.	PC652 AE	CAD/CAM/ CAE Lab	-	-	2	2	25	50	3	1
9.	MC	Mandatory Course	-	-	3	3	50	-	3	0
10.	SI671CS	Summer Internship*	-	-	-	-	-	-		-
Total			**20**		**7**	**27**	**280**	**520**	**-**	**22**

PC: Professional Course **PE**: Professional Elective **OE**: Open Elective **MC**: Mandatory
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note -1:

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

Note-2:

* The students have to undergo a Summer Internship of four weeks duration after VI semester and credits will be awarded in VII semester after evaluation.

****** Subject is not offered to the students of Automobile Engineering Department.

Open Elective-I:

S.No	Course Code	Course Title
1	OE601CE	Disaster Management
2	OE602CE	Geo Spatial Techniques
3	OE601CS	Operating Systems
4	OE602CS	OOP using Java
5	OE601IT	Database Systems
6	OE601EC	Principles of Embedded Systems
7	OE602EC	Digital System Design using Verilog HDL
8	OE601EE	Reliability Engineering
9	OE602EE	Basics of Power Electronics
10	OE601ME	Industrial Robotics**
11	OE602ME	Material Handling**
12	OE632AE	Automotive Safety & Ergonomics**

Professional Elective – I

S.No	Course Code	Course Title
1	PE611AE	Computational Fluid Flow
2	PE612AE	Electric and Hybrid vehicles
3	PE613AE	Material Handling & Earth Moving Vehicles
4	PE614AE	Finite Element Methods

Mandatory Course

S.No	Course Code	Course Title
1	MC951SP	Yoga Practice
2	MC952SP	National Service Scheme
3	MC953SP	Sports

Course Code	Course Title						Core / Elective
PC 601 AE	**DESIGN OF AUTOMOTIVE COMPONENTS**						**Core**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**4**	**--**	**--**	**--**	**30**	**70**	**4**

Course Objectives:

- To introduce the theoretical concepts involved and help in the development of design procedures, under various loading conditions, for the most commonly occurring components in mechanical equipment, such as,
- To know the application of kinematic principles and design concepts for design and sizing of components of an IC engine.
- To understand the applications of
  - springs- helical and leaf Elliptical and semi elliptical;
  - Bearings- sliding and rolling contact of different types;
  - Transmission elements-belts, chains, gears of different types
- To know the automotive gear box, over drive, drive line and differential.

Course Outcomes:

On completion of the course the student must be able to understand and realize,

- The concepts of designing different automotive engine components.
- The concepts of design and design considerations for springs used in automotives like coil springs, leaf springs and the associated accessories.
- The concepts of design and design considerations for sliding & rolling contact bearings.
- The concepts of design and design considerations different power transmission elements like belts & belt-drives, ropes & rope-drives, chain & chain-drives and gears & gear-drives, gear-box, differential, drives like Hotchkiss drive, torque tube drive

UNIT-I

Types of cylinder, piston and valves. Design of cylinder, piston, piston pin, piston rings, tappets, push rod, rocker arms, valves. Design of connecting rod, whipping stress in connecting rod.

Design of crank shaft: Centre crank shaft, overhung crank shaft.

UNIT-II

Springs: Introduction, Different types of springs, materials used for springs, Helical springs, Wahl's factor, calculation of stress, deflection and energy stored in springs, design for static and fluctuating loads. Elliptical and semi elliptical springs: stress and deflection, nipping of leaf springs.

.

UNIT –III

Bearings: Introduction materials used for bearings, Classification of bearings, Viscosity of lubricants, theory of hydrostatic and hydrodynamic lubrication. Design of sliding contact bearings, Design of aerostatic bearings and applications.

Rolling contact bearings: Types of rolling element bearings and their constructional details, static load carrying capacity, dynamic load carrying capacity. Load life relationship, selection of bearing life. Design of cyclic loads and speeds.

UNIT – IV

Design of Transmission Elements-Belts: Stress calculation in flat belt-selection criteria for V-Belt-& Design of Pulleys. Chains: Length and Pitch calculation.

Gears: Introduction to gear drives, different types of gears, materials used for gears. Spur gear design: beam strength of gear tooth, Lewis equation; wear strength of gear tooth, dynamic loads on gear tooth- Buckingham equation. Basic design of Helical, Bevel and worm gears.

UNIT –V

Design of Automotive Gear Box: Selection of type of gears-type of gear train-design of gear shaft& corresponding bearings.

Design of Over Drive: Gear ratio calculations.

Design of Drive Line: Hotchkiss drive-Torque tube drive – Torque & Force calculations.

Differential: Speed ratio and torque calculations.

Suggested Reading

1. V.Bhandari, "*Machine Design"*, Tata McGraw Hill publication,
2. R.K. Jain, *"Machine Design",* Khanna Publishers, New Delhi, 1997.
3. P.C.Sharma and D.K.Aggarwal, "*Machine Design",* S.K.Kataria & sons, 2003
4. A.Kolchin and V.Demidov, *"Design of Automotive Engines"*, MIR Publishers, Moscow, 1984.
5. J.E.Shigley , C.R.Mischke, *"Mechanical Engineering Design"* Tata Mc Graw hill publications.

Course Code	Course Title						Core / Elective
PC602AE	**PERFORMANCE AND TESTING OF AUTOMOTIVE VEHICLES**						**Core**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**3**	**--**	**--**	**--**	**30**	**70**	**3**

Course Objectives:

- To know the estimation of power requirements considering factors such as power train, vehicle accelerations, terrain, and ambient conditions.
- To understand the engine performance characteristics, and parameters affecting efficiency and fuel economy; characteristics of clutches and gear transmission; Steering and brake controls and suspension features
- To understand the testing procedures for major components like suspension, brakes, engine vibrations, fuel economy and road handling including durability, maximum speed, brake testing on roads, hill climbing and ride comfort.

Course Outcomes:

- To Develop Basic Interest About Vehicle Performance
- Identify The Differences Between Various Transmissions.
- An Ability To Identify, Formulate & Solve Engine Performance Problems.
- To Identify Formulate & Solve Related Vehicle Control System Problems
- To Provide Students With Sound Foundation In Vehicle Components Like Clutch, Suspension, Braking, Steering & Engine

UNIT-I

Vehicle Performance Estimation & Prediction: Aerodynamic drag, methods of estimation of resistance to motion, power requirement for propulsion, power plant characteristics. Transmission related requirements, arrangement of power train. Vehicle controls, vehicle acceleration, maximum speed, and gradiability drive systems comparison, hill climbing, handling and ride characteristics on different road surfaces. Effect of pressure, temperature and humidity on power output.

UNIT-II

Vehicle Transmission Performance: Characteristics & features of friction clutches, mechanical gear transmission & Epicyclic gear boxes.

UNIT-III

Operational Performance: Engine performance & operating characteristics, Operation at full load and part load conditions, fuel economy, effect of vehicle condition, tyre and road condition, traffic condition and driving habits on fuel economy, vehicle safety.

UNIT-IV

Control Systems: Braking arrangements & Characteristics, weight transfer, steering arrangements, rigid & independent suspension, roll centre, torsion bar, stabilizer and radius bar.

UNIT-V

Vehicle Performance Testing: Laboratory Testing: Testing of major components of vehicle like clutch, suspension, braking, steering etc., Engine testing – noise, vibrations, emission, power & fuel consumption, Vehicle testing on chassis dynamometers, Road and Track Testing, Initial inspection, running in and durability, extensive driving, maximum speed & acceleration, Brake testing on the road, Hill climbing, handling & ride characteristics on different road surfaces, ride comfort. Corrosion testing, fault finding tests.

Suggested Reading

1. Gousha H. M., “Engine Performance Diagnosis & Tune Up Shop Manual"
2. J. G. Giles, “Vehicle Operation & Performance”.
3. W. H. Crouse & D. L. Anglin, “Motor Vehicle Inspection”.
4. SAE Transactions Papers – 831814 / 820346 / 820367 / 820371 / 820375
5. CIRT & VRDE Manuals

Course Code	Course Title						Core / Elective
PC603AE	**Computer Aided Design Analysis and Manufacturing**						**Core**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Perquisite	**L**	**T**	**D**	**P**			
-	**4**	**--**	**--**	**--**	**30**	**70**	**4**

Course Objectives:

- To know the basic design process design criteria to find alternative solution understand parametric representation of cubic spline, Bezier and B-spline curves along with concepts of NURBS.
- To understand the concepts of surface modeling, analytical surface, solid modeling and their different approaches like C- rep and B-rep along with mass property calculations mechanical tolerance.
- To know the principals of CAD database and its structure and learn the different neutral for mats, like IGES and PDES and basics of FEA.
- To know the different types of numerical control machine tools, its features and elements, CAD/CAM integration and rapid prototyping concepts.

Course Outcomes:

On completion of the course the student must be able to understand and realize, the concepts of

- Basic design process and geometric elements.
- Different 2D transformations like translation, scaling, rotation, shearing and reflection.
- CAD DATA base, basics of FEA, features and elements of numerical control machines.
- Computer numerical control and Industrial Robots.
- Computer aided inspection and quality control

UNIT-I

Design Processes: Computer Aided Design and Computer Aided Manufacturing, Design Process, Product life cycle. Design criteria, CAD Hardware and Workstation.

Geometric Modeling: Wire frame entities and their definition, Interpolation and Approximation curves. Concept of parametric and non-parametric representation of a circle and helix curves, properties of splines.

Synthetic Curves: Parametric representation of cubic spline, Bezier and B-spline curves, properties and characteristics. Concept of NURBS.

UNIT-II

Surface Modeling: Analytic surfaces: Definitions of planar, surface of revolution, Tabulated cylinder, synthetic surfaces: Cubic and Bezier surfaces, coons surface.

Solid Modeling: C-rep and B-rep approaches, feature based and parametric modeling.

2D Transformations: Translation, Scaling and Rotation about arbitrary points, Shearing and Reflection.

UNIT-III

Design Applications: Mass property calculations, Mechanical tolerancing, Finite Element Analysis, Design Review.

CAD Database and Data exchange: CAD Database and structure, CAD Exchange format: IGES, STEP and STL format.

Introduction to Finite element analysis: Introduction, basic concepts, discretization, element types, nodes and degrees of freedom mesh generation, constraints, loads, preprocessing, and application to static analysis.

UNIT-IV

Numerical Control Machine Tools: Features and elements of NC, Positional, paraxial and contouring types. Definitions of axes. Definitions of interpolation, post-processor, preparatory and miscellaneous functions, canned cycles, Tool length and cutter radius compensation. Manual and computer aided part programming (APT) for simple components, programming with MACROS.

Computer Numerical Control: CNC, DNC and Adaptive control systems. Typical configurations and relative features. Machining centers.

UNIT-V

Industrial Robots: Robot Anatomy, Configurations, Controls, Drivers, Programming methods and Applications.
CAPP : Variant and Generative process planning.
FMS&CMS: Building blocks of Flexible Manufacturing systems and their control, Elements of CIMS.
Computer Aided Inspection and QC: Coordinate Measuring Machine, Non contact inspection: Machine vision, Scanning Laser Beam Devices, Quality control.
CAD/CAM Integration, Turkey CAD/CAM Systems, Introduction to Rapid Prototyping Technique, Reverse Engineering.

Suggested Reading

1. Arvid R. Eide, Roland D. Jenison, Lane H. Mashaw, Larry: / Mprtji[. *"Introduction to Engineering Desingg'* McGraw Hill, 1998.
2. Ibrahim Zeid, *CAD/CAM, Theory and Practice,* McGraw Inc. New York, 1991.
3. Grover, MP and Zimmeers E.W. *CAD/CAM,* Prentice Hall of India, 1989.
4. Rao, P.N/ *CAD/CAM: Principles and applications,* 2nd Edition, Tata McGraw Hill, New Delhi, 2004.
5. Yoram Koren, *Computer Control of Manufacturing Systems,* McGraw Hill Int., New York, 1994.
6. Elanchezhian, C. Sunder Selwyn, T. Shanmuga Sunder, G. *computer Aided Manufacturing,* Laxmi Publications (P) Ltd., 2nd Edition, New Delhi, 2007.

Course Code	Course Title						Core / Elective
PC604AE	**PRODUCTION TECHNOLOGY**						**Core**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**3**	**--**	**--**	**--**	**30**	**70**	**3**

Course Objectives:

- To know the different manufacturing processes required to develop mechanical components and identify various process parameters and their effect on defined process characteristics.
- To understand the effect of sand properties on the sand mould and the development of products using casting methods;
- To understand the welding process and the different methods used for joining the similar and dissimilar metals.
- To know the metal forming concepts and the methods used in obtaining mechanical components; Selection of cutting tools and process parameters for obtaining desired machining characteristics.

Course Outcomes:

The student is able to

- Understand the basic working principles of casting, forming and welding.
- Select manufacturing processes for engineering applications and identify plastics for different applications
- Analyze problems in Forging, Rolling, Drawing and Extrusion.
- Select suitable machining process for suitable materials

UNIT-I

Metal Casting: Moulding sand, properties, moulding methods, moulding machines, patterns, types of patterns, pattern materials, pattern allowances, steps involved in making a casting.
Special Casting Processes: Shell moulding, CO_2 process, Continuous casting, die casting, investment casting, centrifugal casting, centrifuging, Defects in casting, causes and remedies.

UNIT-II

Metal Joining: Classification of welding process, Electrode and its specification, Oxy acetylene gas welding, types of flames, oxy acetylene gas cutting.
Arc welding processes: SMAW, SAW, GMAW, TPA, atomic hydrogen welding, plasma arc welding.
Solid State Welding Processes: Friction welding, forge welding, explosive welding and ultrasonic welding.
Resistance Welding Processes: Spot, projection, seam, butt, upset and flash welding process. Introduction to soldering, brazing, braze welding. Defects in welding, causes and remedies.

UNIT-III

Metal Forming Stress: Strain in elastic and plastic deformation, hot working, cold working.
Rolling: Principle of rolling, types of rolling mill, two high rolling mill, three high rolling mill, cluster rolling mill, planetary roll mill, advantages and limitations of rolling.
Forging: Principle of forging, forging operations, types of forging – Smith forging, drop forging, press forging, machine forging, advantages and limitations of forging.
Extrusion: Principle of extrusion, forward extrusion, backward extrusion, tube extrusion, hydrostatic extrusion, impact extrusion.
Drawing : Principle of drawing, wire drawing, tube drawing.
Sheet Metal Working: Blanking, piercing, bending and deep drawing.
Processing of plastics: Blow moulding and injection moulding.

UNIT-IV

Metal Cutting and Machine Tools: Elements of cutting process, cutting tool materials and its properties, nomenclature and geometry of single point cutting tool, chip formation, types of chips, chip breakers.
Machining: Orthogonal and oblique cutting, Merchant analysis, tool life, cutting fluids, Machinability.

UNIT-V

Machine Tools: Lathe: Principle of working, specification, types and operations performed. Lathe attachments, work holding and tool holding devices, taper turning methods – tail stock set over method, compound swivel method, special attachment method,. Capstan and turret lathes.

Types: Specification, working principle, operations performed in shaping, slotting and milling, planning, drilling and boring machines. Introduction to lapping, honing and super finishing operations.

Suggested Reading

1. P.N. Rao, *"*Manufacturing Technology*",* Tata McGraw Hill Publishers, 2nd Edition, 1990
2. Amitaba Ghosh, Malik, "Manufacturing Science*",* Assoc. East West Press Pvt. Limited, 4th Edition, 1991.
3. Roy A Lindberg, "Materials & Processes of Manufacturing", Prentice Hall of India, 5th Edition, 1992.
4. Serope Kalpakjain, "Manufacturing Engineering and Technology", Addison Wesley Publishing Company.
5. P.N. Rao, "Manufacturing Technology – Metal Cutting & Machine Tools", Tata Mc.Graw Hill Publishers, 2nd Edition, 1990.

Course Code	Course Title						Core / Elective
PE 611 AE	COMPUTATIONAL FLUID FLOWS						Professional Elective-I
	Contact hours per week				CIE	SEE	Credits
Prerequisite	L	T	D	P			
-	3	--	--	--	30	70	3

Course Objectives:

- To understand the equations of fluid flow.
- To learn Finite difference method with heat transfer equations and grid generation.
- To learn Finite volume method and staggered grid.

Course Outcomes:

The students are able to

- Apply equations for different types of fluid flow
- Use finite difference method for different for grid generation
- Apply finite volume method for different types of flows

UNIT-I

Review of basic fluid dynamics: Continuity, Momentum and Energy equations-Navier Stokes equations, Reynolds and Favre averaged N-S equations. Heat transfer conduction equations for steady and un-steady flows, Steady convection-diffusion equation

UNIT-II

Introduction to Turbulence: Mixing length model, K-epsilon turbulence model. Classification of partial differential equations-Elliptic, parabolic and hyperbolic equations. Initial and boundary value problems.

UNIT-III

Concepts of finite difference methods-forward, backward and central difference. Finite difference solutions-Parabolic part Contact hours per week differential equations-Euler, Crank Nicholson, Implicit methods. Errors, consistency, stability analysis-Von Neumann analysis. Convergence criteria.

UNIT-IV

Elliptical partial differential equations: Jacobi, Gauss Seidel and ADI methods. Viscous incompressible flow, Stream function-Vorticity method Introduction to grid generation-Types of grid-O, H, C.

UNIT-V

Introduction to finite volume method. Finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows Staggered grid, SIMPLE Algorithm.

Suggested Reading

1. Pradip Niyogi, Chakrabartty S.K, Laha MK, "Introduction to Computational Fluid Dynamics", Pearson Education,2005
2. Muralidhar K, Sundararajan T, "Computational Fluid Flow and Heat Transfer", Narosa Publication House, New Delhi, 2003
3. Chung TJ, "Computational Fluid Dynamics", Cambridge University Press, New York.
4. John D Anderson , "Computational Fluid Dynamics", Me Graw Hill Inc., New York,2003.
5. Patankar SV, "Numerical Heat Transfer and Fluid flow", Hemisphere publishing Company, New York,1980.

Course Code	Course Title						Core / Elective
PE 612 AE	**Electric and Hybrid Vehicles**						**Professional Elective-I**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**3**	**--**	**--**	**--**	**30**	**70**	**3**

Course objectives:

- Understand electric vehicle technology.
- Understand the basics of hybrid and electric drive trains
- Perform design calculations of hybrid system under study
- Understand the various vehicle power sources in hybrid vehicle technology

Course Outcomes:

At the end of the course, student will be able to

- Realize and demonstrate different types of electric vehicle technologies.
- Demonstrate drive system and power plant technologies in electric vehicles.
- Explain and demonstrate design, working of hybrid vehicles and electric drive trains and analyze with different case studies.

UNIT- I

Electric Vehicle Propulsion and Energy Sources : Introduction Electric Vehicles, Vehicle Mechanics - Kinetics And Dynamics, Roadway Fundamentals, Propulsion System Design - Force Velocity Characteristics, Calculation Of Tractive Power And Energy Required, Electric Vehicle Power Source - Battery Capacity, State Of Charge And Discharge , Specific Energy, Specific Power, Ragone Plot, Battery Modeling - Run Time Battery Model, First Principle Model, Battery Management System- SOC Measurement, Battery Cell Balancing. Traction Batteries - Nickel Metal Hydride Battery, Li-Ion, Li-Polymer Battery.

UNIT-II

Electric Vehicle Power Plant and Drives: Introduction Electric Vehicle Power Plants, Induction Machines, Permanent Magnet Machines, Switch Reluctance Machines, Power Electronic Converters-DC/DC Converters – Buck Boost Converter, Isolated DC/DC Converter, Two Quadrant Chopper And Switching Modes, AC Drives-PWM, Current Control Method, Switch Reluctance Machine Drives - Voltage Control, Current Control.

UNIT-III

Hybrid and Electric Drive trains : Introduction Hybrid Electric Vehicles, History And Social Importance, Impact Of Modern Drive Trains In Energy Supplies, Hybrid Traction And Electric Traction, Hybrid And Electric Drive Train Topologies, Power Flow Control And Energy Efficiency Analysis, Configuration And Control Of Dc Motor Drives And Induction Motor Drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drives, Drive System Efficiency

UNIT-IV

Electric and Hybrid Vehicles - Case Studies: Parallel Hybrid, Series Hybrid -Charge Sustaining, Charge, Depleting, Hybrid Vehicle Case Study –Toyota Prius, Honda Insight, Chevrolet Volt, V System For Traction Applications, Lightly Hybridized Vehicles and Low Voltage System, Electric Vehicle Case Study - GM EV1,Nissan Leaf, Mitsubishi Miev, Hybrid Electric Heavy Duty Vehicles, Fuel Cell Heavy DutyVehicles.

UNIT-V

Electric and Hybrid Vehicle Design: Introduction to Hybrid Vehicle Design, Matching, The Electric Machine And The Internal Combustion Engine Sizing Of Propulsion Motor, Power Electronics, Drive System. Selection of Energy Storage Technology, Communications, Supporting Subsystem, Energy Management Strategies, In Hybrid and Electric, Vehicles - Energy Management Strategies- Classification, Comparison, Implementation, Design of a Hybrid Electric Vehicle, Design of a Battery Electric Vehicle

Suggested Reading

1. Iqbal Husain, "Electic and Hybrid vehicles Design Fundamentals" , CRC Press, second enition 2013
2. James Larminie, John Lowry, "Electric vehicle techonology Explained" 2nd Ed.,Wiley 2012
3. Ali Emadi, "Hand book of Automotive Power Electronics and Motor Drives" ,CRC Press 2005
4. Ali Emadi, MehrdadEhsani, John M. Muller,“Vehicular Electric Power Systems” Marcel Dekker, Inc., 2004

Course Code	Course Title						Core / Elective
PE 613 AE	**MATERIAL HANDLING AND EARTH MOVING VEHICLES**						**Core**
	Contact hours per week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**3**	**-**	**--**	**--**	**30**	**70**	**3**

Course Objectives:

- Introduced the heavy earth moving vehicles and material handling equipments
- To know the working of different types of off road vehicles
- To understand the working and construction of the hoisting equipment
- Classify the off road vehicle

Course Outcomes:

- Students able to distinguish the on road and off road vehicle and understand the complexity in off road vehicles.
- Understand Working and construction of the machines and equipment.
- Maintain and repair condition of working machines and equipment, for scheduling to maintenance

UNIT-I

Material Handling Systems: Design and construction of various components of mechanical handling conventional belt conveyors, high angle conveyors, cable belt conveyor, chain conveyors, stackers, Re-claimers, wagon loaders, wagon tipplers, bucket elevators, bins, bunkers, silos, selection, productivity and power calculations conveyors.

UNIT-II

Hoisting Equipments: Mobile jib cranes–different types, EOT cranes, pillar cranes, lower cranes, gantry cranes, radial cranes. Hoist, Travel and slew mechanisms of mechanical handling equipment. Stability of mobile cranes. Programmable and flexible load handling devices, automation in the handling of material

UNIT-III

Classification and Requirements Of Off Road Vehicles: Land clearing machines Earth moving machines shovels - drag lines - ditchers - capacity of shovels. Land clearing machines: Bush cutter, tree dozer, rippers.

UNIT-IV

Transport Equipment: Powered equipment, Tractors and Trailers, Platform lift trucks, Fork lift trucks, containers and Supports. Hauling equipment: Types of dump trucks, On-high way vehicles, Off high way vehicles. Tractors, Applications of tractors, Rating of Tractors, Wheeled and Crawler tractor, recent trends in tractor design

UNIT-V

Earth Moving Machines: Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, scrapers, drag and self-Powered types - dump trucks and dumpers - loaders, single bucket, multi bucket and rotary types - power and Capacity of earth moving machines .Scrapers, elevating graders, self-powered scrapers and graders. Shovels and Ditchers: Power shovel, revolving and stripper

Suggested Reading

1. N Rudenko .“Material Handling Equipment”;
2. Spivakovosky, V. Dyachk .“Conveyors and Related Equipment”,
3. Abrosimov. K. Bran berg.A. and Katayer.K., “Road making Machinery”, MIR Publishers, Moscow, 1971
4. Wang.J.T., “Theory of Ground vehicles”, John Wiley & Sons, New York, 1987.
5. “Off the road wheeled and combined traction devices” - Ashgate Publishing Co. Ltd. 1998
6. R.L. Peurifoy, “Construction Planning Equipment and Methods”, McGraw Hill Publishers, 1956
7. Mahesh Varma, “Construction Equipment and its Planning and Applications”, Metropolitan Books Co., Delhi, 2004
8. M P Alexandrov “Materials Handling Equipment”, , MIR Publishers.
9. “Good year hand book of belting, conveyor and elevator”

Course Code	Course Title						Core / Elective
	FINITE ELEMENT METHODS						**Elective**
PE 614 AE	**Contact hours per week**				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
	3	**-**	**--**	**--**	**30**	**70**	**3**

Course Objectives:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To understand the theory and application of the Finite element method for analyzing
- Structural systems. To learn Approximation theory for structural problems as the basis for finite element methods
- To learn formulations for a variety of elements in one ,two, and three dimensions.
- To understand modeling and analysis of structures using planar, solid, and plate elements.

Course Outcomes:

The student is able to

- Develop element stiffness matrix relations for one dimensional element using Potential energy relations and applying the structural load vectors and load vectors due to Uniform Temperature change.
- Discuss the concepts of Finite Element Modelling by Galerkin's approach. Solve steady state heat transfer analysis of a fin problem using one-dimensional thermal element and applying fixed and natural boundary conditions.
- Develop global stiffness matrix for a plane stress and plane strain conditions on a CST element.
- Develop global stiffness matrix and apply boundary conditions on nodal degrees of freedom to determine nodal displacements, nodal reactions and element stresses within a truss element.
- Solve the dynamic parameters – natural frequencies, Eigen values, Eigen vectors for one-dimensional Stepped bar and beam problems using bar and beam elements respectively.

UNIT-I

Introduction: Mathematical Modelling of field problems in Engineering Stress- Strain relation, Governing Equation, Discrete and continuous models, Boundary, Initial and Eigen value problems, Weighted Residual Methods, Variation formulation of Boundary Value Problems, Ritz Technique, Basic concepts of the Finite Element Method.

UNIT-II

One Dimensional Problem: Finite Element modelling, local global and natural coordinates, and shape function, Potential Energy approach; Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT-III

Finite Element Modelling: Finite element modelling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Two dimensional four nodded iso-parametric elements and numerical integration using Gaussian Quadrature.

Steady state heat transfer analysis: One dimensional Heat transfer analysis of a fin with conduction and convection

UNIT-IV

Analysis of Trusses and Beams: Analysis of plane truss with two degrees of freedom at each node. Analysis of Beams: Element stiffness matrix for two nodes (Two degrees of freedom per node)

UNIT-V

Dynamic Analysis: Formulation of finite element model, element matrices, Evaluation of Eigen values and eigenvectors for a stepped bar and a beam, Time-dependent field problems: Application to one-dimensional heat flow in a rod. Introduction to finite element formulation of three-dimensional problems in stress analysis, convergence requirements. Introduction to Finite Element Analysis Software.

Suggested Reading

1. G. Ramamurthy, "Applied Finite Element Analysis", I.K. International Publishing House Pvt. Ltd., New Delhi, 2009.
2. Tirupathi R, Chandraputla and Ashok D Belagundu, '"Introduction to Finite Elements in Engineering"', Practice Hall of India, 1997.
3. Rao S.S, '"The Finite Element Method in Engineering"', Pergamon Press, 1989.
4. Segerlind L J, '"Applied Finite Element Analysis"', Wiley Eastern, 1984.
5. Reddy J N, '"An Introduction to Finite Element Method"', McGraw-Hill, 1984.

Course Code	Course Title						Core / Elective
	PRODUCTION TECHNOLOGY LAB						**Core**
PC 651 AE	**Contact hours per week**				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**--**	**--**	**--**	**2**	**25**	**50**	**1**

Course Objectives: Students will gain knowledge of

- The different manufacturing processes required to develop mechanical components and identify various process parameters and their effect on defined process characteristics.
- Different metal cutting operations on varied machines, selection of cutting tools and process parameters for obtaining desired machining characteristics.
- Effect of sand properties on the sand mould and the development of products using casting methods; phenomenon of welding process and the different methods used for joining the similar and dissimilar metals.
- Metal forming concepts and the methods used in obtaining mechanical components.

Course Outcomes: On completion of the course the student must be able to

- Understand and realize different metal cutting processes and their applications
- Understand and realize different foundry technologies and practices
- Understand and realize different welding methods, their applications and Do's & Don't's during welding processes.
- Understand and realize different metal forming methods and techniques.

List of Experiments

Metal Cutting

1. Perform Step turning & Taper turning operations for a given dimension on Lathe Machine.
2. Perform Thread Cutting & Knurling operation s for a given dimension on Lathe Machine.
3. Perform drilling & tapping operations on the PCD of a given cylindrical component on Radial Drilling Machine.
4. Develop a gear for a given dimension on milling Machine.

Foundry

5. Single piece pattern making with wood as material considering allowances (Draft, Shrinkage and Machining).
6. Green sand mould making processes with complete sprues, gates ,riser design.
7. Testing of green sand properties.
8. Melting ad casting of aluminum metal

Welding

9. Prepare a butt joint using arc welding process and determine deposition efficiency of electrodes.
10. Exercises using TIG and MIG welding processes.

Forming

11. Evalution of formability using Erichsen Cupping test.
12. Performing blanking and piercing operations using Mechanical / fly presses.
13. Manufacturing of simple component using Plastic Injection Moulding machine

Suggested Reading:

1. P.N. Rao, Manufacturing Teachnology, Tata McGraw Hill Publishers,2nd Edition, 1990
2. Amitaba Ghosh, Malik, Manufacturing Science, Assoc. East West Press Pvt. Limited, 4th Edition,1991.
3. Roy A Lindberg, Materials & Processes of Manufacturing, Prentice Hall of India, 5th Edition,1992.
4. P.N.Rao,Manufacturing Technology-Metal Cutting $& Machine Tools, Tata Mc.Graw Hill Publishers, 2nd Edition,1990.

Note: Minimum ten experiments should be conducted in the semester

Course Code	Course Title						Core / Elective
	CAD/ CAM/ CAE LAB						**Core**
PC 652 AE	**Contact hours per week**				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**--**	**--**	**--**	**2**	**25**	**50**	**1**

Course Objectives: Students will gain knowledge of

- To Become familiar with Full-Scale CAD Software systems designed for geometric modelling of engineering components.
- Gaining knowledge of Analysis of mechanical components under static conditions using Finite Element Techniques.
- Becoming familiar with CNC machine tools, Its features and elements, practice manual part programming using miscellaneous and preparatory functions (M & G codes).
- Getting exposed to the manufacturing process through flexible manufacturing Systems.

Course Outcomes: On completion of the course the student must be able to

- Understand and realize the structure of tools and their categorization
- Must be able to execute all commands of Pro-E / I-DEAS / Solid works / MDT /CATIA, ANSYS, NASTRAN / ADINA, CODING in CNC and apply to some standard real time applications.

List of Experiments

CAD

1. Practice in the use of some of the packages like: Pro-E / I-DEAS / Solid works / MDT / Inventor / CATIA etc., for Geometric modeling of simple parts (sketching).
2. Part modeling and assembly of simple parts using any of the above packages.
3. Mass properties and Sectional properties of a part and Assembly.

CAE

4. Static Analysis of Plane Truss and 2D beam for different type of loads using ANSYS / NASTRAN / ADINA etc
5. Static analysis of 2D beam for different types of loads using beam elements

CAM

6. Facing, Turning, Step turning, Taper turning on CNC Lathe
7. Pocketing and Contouring on CNC milling
8. Programming for integration of various CNC machines, robots and material handling systems

Course Code	Course Title						Core / Elective
OE 601 CE	**DISASTER MANAGEMENT**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

Course Outcomes

- The students will be able to understand impact on Natural and manmade disasters.
- Able to classify disasters and destructions due to cyclones
- Able to understand disaster management applied in India

UNIT-I

Introduction to Disasters: Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks. Natural and Manmade disasters, impact of drought, review of past disasters and drought in India, its classification and characteristics. Classification of drought, causes, Impacts (including social, economic. political, environmental, health, psychosocial, etc.).

UNIT-II

Disaster: Classifications, Causes, Impacts including social, economic, political, environmental, health, psychosocial etc. Differential Impacts, in terms of caste, class, gender, age, location, disability Global trends in disasters, urban disasters, pandemics, complex emergencies, climate change. Cyclones and Floods: Tropical cyclones & Local storms, Destruction by tropical cyclones and local storms, Cumulative atmospheric hazards/ disasters, Cold waves, Heat waves, Causes of floods, Rood hazards in India.

UNIT-III

Approaches to Disaster Risk Reduction: Disaster cycle, its analysis, Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural sources, roles and responsibilities of community, Panchayati Raj Institutions/Urban Local Bodies (PRis/ULBs), states, Centre, and other stake-holders.

UNIT-IV

Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, differential impacts, impact of development projects such as darns, embankments, changes in Land-use etc. Climate Change, Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-V

Disaster Risk Management in India: Hazard and Vulnerability profile of India

Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, OM Act and Policy, other related policies, plans, programmes and legislation)

Field Work and Case Studies: The field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located.

Suggested readings:

1) Sharma V. K., "**Disaster Management, National Centre for Disaster Management**", IIPE, Delhi, 1999.
2) Gupta Anil K, and Sreeja S. Nair., "**Environmental Knowledge for Disaster Risk Management"**, NIDM, New Delhi, 2011.
3) Nick., **"Disaster Management: A Disaster Manager's Handbook"** Asian Development Bank, Manila Philippines, 1991.
4) Kapur, et al. , "**Disasters in India Studies of Grim Reality"**, Rawat Publishers, Jaipur, 2005.
5) Pelling Mark, "**The Vulnerability of Cities**: **Natural Disaster and Social Resilience**", Earth scan publishers, London, 2003.

Course Code	Course Title						Core / Elective
OE 602 CE	**GEO-SPATIAL TECHNIQUES**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- Description about various spatial and non-spatial data types, and data base management techniques
- Development of the concepts and professional skills in utility of geospatial techniques Enhancement of knowledge of geospatial techniques to field problems

Course Outcomes

- The students will be able to understand and apply GIS tools
- Will be able to analyse and process data to apply to the GIS tools.
- Will be able assimilate knowledge on field problems using remote sensing

UNIT I

Introduction: Basic concepts, socioeconomic challenges, fundamentals of geographical information systems (GIS), history of geographical information system, components of geographical information systems. Projections and Coordinate Systems: Map definitions, representations of point, line, polygon, common coordinate system, geographic coordinate system, map projections, transformations map analysis.

UNIT II

Data Acquisition and Data Management: data types, spatial, non-spatial (attribute) data, data structure and database management, data format, vector and raster data representation, object structural model filters and files data in computer, key board entry, manual digitizing, scanner, aerial photographic data, remotely sensed data, digital data, cartographic database, digital elevation data, data compression, data storage and maintenance, data quality and standards, precision, accuracy, error and data uncertainty. Data Processing: Geometric errors and corrections, types of systematic and non-systematic errors, radiometric errors and corrections, internal and external errors.

UNIT III

Data Modeling: Spatial data analysis, data retrieval query, simple analysis, recode overlay, vector data model, raster data model, digital elevation model, cost and path analysis, knowledge based system. GIS Analysis and Functions: Organizing data for analysis, analysis function, maintenance and analysis of spatial data, buffer analysis, overlay analysis, transformations, conflation, edge matching and editing, maintenance and analysis of spatial and non-spatial data

UNIT IV

Applications of GIS: Environmental and natural resource management, soil and water resources, agriculture, land use planning, geology and municipal applications, urban planning and project management, GIS for decision making under uncertainty, software scenario functions, standard GIS packages, introduction to Global Positioning Systems (GPS) and its applications.

UNIT V

Introduction to Remote Sensing: General background of remote sensing technology, objectives and limitations of remote sensing, electro-magnetic radiation, characteristics, interaction with earth surface and atmosphere, remote sensing platforms and sensors, satellite characteristics, digital image processing, IRS series and high resolution satellites, software scenario functions, remote sensing applications to watershed modeling, environmental modeling, urban planning and management.

Suggested readings:

1) Burrough, P. A., and McDonnell R. A., '**Principles of Geographical Information Systems'**, Oxford University Press, New York, 1998.
2) Choudhury S., Chakrabarti, D., and Choudhury S. **'An Introduction to Geographic Information Technology**', I.K. International Publishing House (P) Ltd, New Delhi, 2009.
3) Kang-tsung Chang , "**Introduction to Geographical information Systems'**, Tata McGraw-Hill Publishing Company Ltd., Third Edition, New Delhi, 2006.
4) Lilysand T.M., and Kiefer R.W. '**Remote Sensing and Image Interpretation'**, John Wiley and Sons, Fourth Edition, New York, 2002.
5) Tor Bernhardsen, **'Geographical Information System'**, Wiley India (P) Ltd., Third Edition, New Delhi, 2002.
6) Hoffman-Wellenhof, B, et al. '**GPS Theory and Practice'**, Fourth Edition, Springer Wein, New York, 1997.

Course Code	Course Title						Core / Elective
OE 601 CS	**OPERATING SYSTEMS**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- To understand CPU, Memory, File and Device management
- To learn about concurrency control, protection and security
- To gain knowledge of Linux and Windows NT internals

Course Outcomes

- Explain the components and functions of operating systems.
- Analyze various Scheduling algorithms.
- Apply the principles of concurrency
- Compare and contrast various memory management schemes
- Perform administrative tasks on Linux Windows Systems

UNIT-I

Introduction to Operating Systems: OS structure and strategies, Process concepts, Threads, Inter process communication. CPU scheduling algorithms, Process synchronization, Critical section problem, Semaphores, Monitors.

UNIT-II

Memory Management: Swapping, Contiguous allocation, Paging, Static and Dynamic partitions, Demand paging, Page replacement algorithms, Thrashing, Segmentation, Segmentation with paging. File system interface: File concepts, Access methods and protection. File system implementation: File system structure, Allocation methods, Directory implementation.

UNIT-III

Deadlocks: Necessary conditions, Resource allocation graph, Methods for handling deadlocks, Prevention, Avoidance, Detection and Recovery. Protection: Goals, Domain of protection, Access matrix. Security: Authentication, Threat monitoring, Encryption. UNIT-IV Device Management: Disk scheduling methods, Disk management, Device drivers and interfaces, CPU- Device interactions, I/O optimization.

UNIT-V

Case Studies: The Linux System, Design principles, Kernel modules, Process management, Scheduling, Memory management, File systems, Input and Output, Inter process communication Windows NT, General Architecture, The NT kernel, The NT executive

Suggested readings:

1) Abraham Silberschatz, Peter B Galvin, ***"Operating System Concepts",*** Addison Wesley, 2006
2) William Stallings, "***Operating Systems-Internals and Design Principles"***, 8th edition, Pearson, 2014
3) Andrew S Tanenbaum, "***Modern Operating Systems"***, 4th edition, Pearson, 2016.

Course Code	Course Title						Core / Elective
OE 602 CS	**OOPS USING JAVA**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- To introduce fundamental object oriented concepts of Java programming Language, such as classes, inheritance packages and interfaces.
- To introduce concepts of exception handling and multi-threading.
- To use various classes and interfaces in java collection framework and utility classes.
- To understand the concepts of GUI programming using AWT controls.
- To introduce Java I/O streams and serialization

Course Outcomes

- Able to develop java applications using OO concepts and packages.
- Able to write multi-threaded programs with synchronization
- Able to implement real world applications using java collection frame work and I/O classes Able to write Event driven GUI programs using AWT/Swing

UNIT – I

Object Oriented System Development: understanding object oriented development, understanding object oriented concepts, benefits of object oriented development. Java Programming Fundamentals: Introduction, overview of Java, data types, variables and arrays, operators, control statements

UNIT – II

Java Programming Object Oriented Concepts: classes, methods, inheritance, packages and interfaces. Exceptional Handling, Multithreaded Programming

UNIT – III

I/O Basics, Reading Console Input and Output, Reading and Writing Files, Print Writer Class, String Handling Exploring Java. Lang, Collections Overview, Collection Interfaces, Collection Classes, Iterators, Random Access Interface, Maps, Comparators, Arrays, Legacy Classes and Interfaces, String Tokenizer

UNIT – IV

Introducing AWT Working with Graphics: AWT Classes, Working with Graphics Event Handling: Two Event Handling Mechanisms, the Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces. AWT Controls: Control Fundamentals, Labels, Using Buttons, Applying Check Boxes, Check box Group, Choice Controls, Using Lists, Managing Scroll Bars, Using Text Field, Using Text Area, Understanding Layout Managers, Menu bars and Menus, Dialog Boxes, File Dialog, Handling events by Extending AWT Components, Exploring the controls, Menus and Layout Managers.

UNIT – V

Java I/O Classes and Interfaces: Files, Stream and Byte Classes, Character Streams, Serialization.

Suggested readings:

1) Herbert Schildt, "**The Complete Reference JAVA"**, Tata McGraw Hill, 7thEdition, 2005
2) James M Slack, **"Programming and Problem Solving with JAVA"**, Thomson learning, 2002
3) C.Thomas Wu,**"An Introduction to Object-Oriented Programming with Java"**, Tata McGraw Hill, 5thEdition, 2005.

Course Code	Course Title						Core/Elective
OE601IT	**DATABASE SYSTEMS**						**Elective**
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To introduce E-R Model and Normalization
- To learn formal and commercial query languages of RDBMS
- To understand the process of database application development
- To study different database architectures
- To introduce security issues in databases

Course Outcomes:

Student will be able to:

- Understand the mathematical foundations of Database design
- Model a set of requirements using the Entity Relationship (E-R)Model , transform an E-R model into a relational model ,and refine the relational model using theory of Normalization
- Understand the process of developing database application using SQL
- Understand the security mechanisms in RDBMS

UNIT 1

Design: Conceptual design (E-R modeling), the relational model, normalization

UNIT II

Queries: algebra and logic (relational algebra and calculus), relational query languages and queries (namely SQL),select, project, join, union, intersection, except, recursion, aggregation, data manipulation

UNIT III

Applications: application development, database application interfaces (e.g., JDBC), internet applications,proper database application paradigms, transactions, transaction management, concurrency control, crash recovery

UNIT IV

Distributed DB, Architecture, Query processing and Optimization in Distributed DB, Introduction to NoSQL Databases, Graph databases, Columnar Databases

UNIT V

Introduction to Database Security Issues, Security mechanism, Database Users and Schemas, Privileges

Suggested Books

1. Jim Melton and Alan R. Simon.SQL 1999: Understanding Relational Language Components.First Edition, 1999.Morgan Kaufmann Publishers.
2. Don Chamberlin.Using the New DB2: IBM's Object-Relational Database System.First Edition, 1996.Morgan Kaufmann Publishers.
3. Database System Concepts Sixth Edition, by Abraham Silberschatz , Henry F Korth, S Sudarshan,Mc Graw-Hill Education
4. Fundamentals of Database Systems , Elmasri, Navathe, Sixth Edition , Addison- Wesley

Course Code	Course Title						Core / Elective
OE 601 EC	**PRINCIPLES OF EMBEDDED SYSTEMS**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	**30**	**70**	3

Course Objectives

- To understand the fundamentals of embedded systems
- To study the block diagram and advanced hardware fundamentals
- To study the software architecture of embedded systems
- To learn the tool chain of embedded systems
- To understand the tools and debugging process of embedded systems.

Course Outcomes

Student will be able:

- To acquire an overview of what an embedded system implies
- To understand the architecture of a microprocessor and microcontroller to enable to design embedded applications using them.
- To apply theoretical learning to practical real time problems for automation.
- To understand how to build and debug an embedded system application.
- To analyze and design real world applications and interface peripheral devices to the microprocessor.

UNIT – I

Fundamentals of Embedded Systems: Definition of Embedded system, Examples of Embedded Systems, Typical Hardware, Terminology, Gates, A few other basic considerations, Timing Diagrams, Memory

UNIT – II

Advanced Hardware Fundamentals: Microprocessors, Buses, Direct Memory Access, Interrupts, Other Common Parts, Built-Ins on the Microprocessor, Conventions used in Schematics, Microprocessor Architecture, Interrupts Basics, Shared Data Problem, Interrupt Latency.

UNIT – III

Software Architecture of Embedded Systems: Round- Robin, Round-Robin with Interrupts, Function- Queue-Scheduling Architecture, Real- Time Operating System Architecture, Selecting Architecture

UNIT – IV

Embedded Software Development Tools: Host and Target Machines, Cross compilers, Cross Assemblers and Tool Chains, Linkers /Locaters for Embedded Software, Getting Embedded Software into Target System: PROM programmers, ROM Emulators, In-Circuit Emulators.

UNIT – V

Debugging Techniques: Testing on your host machine, Instruction Set Simulators, The assert Macro, Using Laboratory Tools

Suggested readings:

1) David. E. Simon, "**An Embedded Software Primer**", Low price edition, Pearson Education, New Delhi, 2006.
2) Frank Vahid and Tony Givargis "**Embedded System Design: A Unified Hardware/Software. Approach"**. John Wiley & Sons, October 2001.
3) Rajkamal, "**Embedded systems: Programming, architecture and Design",** second edition, McGraw-Hill Education (India), March 2009.

Course Code	Course Title						Core / Elective
OE 602 EC	**DIGITAL SYSTEM DESIGN USING VERILOG HDL**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	**30**	**70**	3

Course Objectives

- Describe Verilog hardware description languages (HDL).
- Develop Verilog HDL code for combinational digital circuits.
- Develop Verilog HDL code for sequential digital circuits.
- Develop Verilog HDL code for digital circuits using switch level modeling and describes system tasks, functions and compiler directives
- Describes designing with FPGA and CPLD.

Course Outcomes

After completion of this course, students should be able:

- To understand syntax of various commands, data types and operators available with verilog HDL
- To design and simulate combinational circuits in verilog
- To design and simulate sequential and concurrent techniques in verilog
- To write Switch level models of digital circuits
- To implement models on FPGAs and CPLDs

UNIT I

Introduction to Verilog HDL: Levels of Design Description, Concurrency, Simulation and Synthesis, Function Verification, System Tasks, Programming Language Interface, Module, Simulation and Synthesis Tools

Verilog Data Types and Operators: Binary data manipulation, Combinational and Sequential logic design, Structural Models of Combinational Logic, Logic Simulation, Design Verification and Test Methodology, Propagation Delay, Truth Table models using Verilog.

UNIT II

Combinational Logic Circuit Design using Verilog: Combinational circuits building blocks: Multiplexers, Decoders , Encoders , Code converters, Arithmetic comparison circuits, Verilog for combinational circuits , Adders-Half Adder, Full Adder, Ripple-Carry Adder, Carry Lookahead Adder, Subtraction, Multiplication.

UNIT III

Sequential Logic Circuit Design using Verilog: Flip-flops, registers & counters, synchronous sequential circuits: Basic design steps, Mealy State model, Design of FSM using CAD tools, Serial Adder Example, State Minimization, Design of Counter using sequential Circuit approach.

UNIT IV

Switch Level Modeling: Basic Transistor Switches, CMOS Switches, Bidirectional Gates, Time Delays with Switch Primitives, Instantiation with Strengths and Delays, Strength Contention with Trireg Nets.

System Tasks Functions and Compiler Directives: Parameters, Path Delays, Module Parameters. System Tasks and Functions, File Based Tasks and Functions, Computer Directives, Hierarchical Access, User Defined Primitives.

UNIT V

Designing with FPGAs and CPLDs: Simple PLDs,ComplexPLDs,Xilinx 3000 Series FPGAs, Designing with FPGAs, Using a One-Hot State Assignment, Altera Complex Programmable Logic Devices (CPLDs), Altera FLEX 10K Series CPLDs.

Suggested readings:

1) T.R. Padmanabhan, B Bala Tripura Sundari, "**Design Through Verilog HDL**", Wiley 2009.
2) Samir Palnitkar, "**Verilog HDL**", 2nd Edition, Pearson Education, 2009.
3) Stephen Brown, Zvonko Vranesic , "**Fundamentals of Digital Logic with Verilog Design**, TMH, 2nd Edition 2003.

Course Code	Course Title						Core / Elective
OE 601 EE	**RELIABILITY ENGINEERING**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	**30**	**70**	3

Course Objectives

- To understand the concepts of different types of probability distributions importance of reliability evaluation of networks.
- To make the students understand about Reliability, availability model of Power Systems and markov modeling of Power Plants. With identical and no identical units.

Course Outcomes

- Able to understand the meaning of discrete and continuous random variables and their significance, causes of failures of a system.
- Able to acquire the knowledge of different distribution functions and their applications.
- Able to develop reliability block diagrams and evaluation of reliability of different systems.

UNIT- I

Discrete and Continuous Random Variables: probability density function and cumulative distribution function, Mean and Variance, Binomial, Poisson, Exponential and Weibull distributions.

UNIT, II

Failure and Causes of Failure: Failure rate and failure density, Reliability function and MTTF, Bath tub curve for different systems, parametric methods for above distributions, Non- Parametric methods from field data.

UNIT- III

Reliability Block Diagram: Series and parallel systems, Network reduction technique, Examples, Evaluation of failure rate, MTTF and reliability, Active and Standby Redundancy, r out of n configuration. Non-series, parallel systems. Path based and cut set methods.

UNIT- IV

Availability, MTTR and MTBF: Markov models and State transition matrices, Reliability models for single component, two components, Load sharing and standby systems, Reliability and availability models of two unit parallel system with repair and standby systems with repair.

UNIT- V

Repairable Systems: Maintainability, Preventive maintenance, Evaluation of reliability and J1TTF, Overhauling and replacement, Optimum maintenance policy, Markov model of a power plant with identical units and non-identical unit, Capacity outage probability table. Frequency of failures and Cumulative frequency

Suggested readings:

1) Charles E.Ebeling, "**Reliability and Maintainabelity Engineering**", Mc Graw Hill International Edition, 1997.
2) Balaguruswamy, "**Reliability Engineering,**"Tata McGraw Hill Publishing company Ltd,1984.
3) R.N.Allan. "**Reliability Evaluation of Engineering Systems**", Pitman Publishing, 1996.
4) Endrenyi. "Reliability Modelling in Electric Power Systems". JohnWiley & Sons, 1978.

Course Code	Course Title						Core / Elective
OE602EE	BASICS OF POWER ELECTRONICS						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	30	70	3

Course Objectives

- To be able to understand various power switching devices, characteristics and applications.
- To learn and understand the various converters like rectifiers, choppers and inverters principle operation, characteristics and applications.

UNIT I: Power Switching Devices

Concept of power electronics, scope and applications, types of power converters; Power semiconductor switches and their V-I characteristics - Power Diodes, Power BJT, SCR, Power MOSFET, Power IGBT; Thyristor ratings and protection, methods of SCR commutation, UJT as a trigger source, gate drive circuits for BJT and MOSFETs

UNIT II: AC-DC Converters (Phase Controlled Rectifiers)

Principles of single-phase fully-controlled converter with R, RL, and RLE load, Principles of single-phase half-controlled converter with RL and RLE load, Principles of three-phase fully-controlled converter operation with RLE load, Effect of load and source inductances, General idea of gating circuits, Single phase and Three phase dual converters

UNIT III: DC-DC Converters (Chopper/SMPS)

Introduction, elementary chopper with an active switch and diode, concepts of duty ratio, average inductor voltage, average capacitor current Buck converter - Power circuit, analysis and waveforms at steady state, duty ratio control of output voltage. Boost converter - Power circuit, analysis and waveforms at steady state, relation between duty ratio and average output voltage. Buck-Boost converter - Power circuit, analysis and waveforms at steady state, relation between duty ratio and average output voltage

UNIT IV: DC-AC Converters (Inverters)

Introduction, principle of operation, performance parameters, single phase bridge inverters with R, RL loads, 3-phase bridge inverters - 120 and 180 degrees mode of operation, Voltage control of single phase inverters –single pulse width modulation, multiple pulse width modulation, sinusoidal pulse width modulation.

UNIT V: AC-AC Converters

Phase Controller (AC Voltage Regulator)-Introduction, principle of operation of single phase voltage controllers for R, R-L loads and its applications. Cycloconverter-Principle of operation of single phase cycloconverters, relevant waveforms, circulating current mode of operation, Advantages and disadvantages

Suggested Reading:

1) Singh.M.D and Khanchandani.K.B, Power Electronics, Tata McGraw Hill, 2nd Edition, 2006.
2) Rashid.M.H, Power Electronics Circuits Devices and Applications. Prentice Hall of India, 2003
3) M.S.Jamil Asghar, Power Electronics, Prentice Hall of India, 2004 With effect from Academic Year 2016-2017
4) Bimbra.P.S, Power Electronics, Third Edition, Khanna Publishers, 1999
5) Mohan, Undeland, Robbins, Power Electronics, John Wiley, 1996

Course Code	Course Title						Core / Elective
OE 601 ME	**INDUSTRIAL ROBOTICS**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- To familiarize the student with the anatomy of robot and their applications.
- To provide knowledge about various kinds of end effectors usage.
- To equip the students with information about various sensors used in industrial robots.
- To make the student understand the importance of spatial transformation of robots using forward and inverse kinematics.
- To specify and provide the knowledge of techniques involved in robot vision in industry.
- To equip students with latest robot languages implemented in industrial manipulators.

Course Outcomes

- Able to demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics and have an understanding of the functionality and limitations of robot actuators and sensors.
- Able to demonstrate an ability to apply spatial transformation to obtain forward/Inverse kinematics equation of robot manipulators using analytical/numerical/simulation tools.
- Able to apply knowledge and choose the best & economically suitable sensors/end effectors required for specific applications.
- Able to understand the importance of robot vision and apply the learnt techniques to get the required information from input images.
- Able to design and develop a industrial robot for a given purpose economically.
- Appreciate the current state and potential for robotics in new application areas.

UNIT – I

Introduction to Robotics: Basic structure of Robots. Degree of freedom of Robots, Work envelope, Classification of Robots based on Drive Technology, Work-Envelope and motion control methods. Application of Robots in Industry, Repeatability, Precision and Accuracy as applied to Robots, Specifications of robots used for various applications. End effectors, Grippers: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers, Two fingered and three fingered grippers, internal grippers and external grippers, Selection and design considerations.

UNIT – II

Requirements of a Sensor: Principles and Applications of the following types of sensors- Position of sensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors), Range sensors (Triangulation principle, Structured, Lighting approach, Time of flight range finders, Laser range meters), Proximity sensors (Inductive, Hall effect, Capacitive, Ultrasonic and Optical proximity sensors), Touch sensors (Binary sensors, Analog sensors), Wrist Sensors, Compliance Sensors, Slip Sensors.

UNIT – III

Kinematic Analysis of Robots: Rotation matrix. Homogeneous transformation matrix, Denavit & Hartenberg representation, Euler and RPY angles representation. Representation of absolute position and orientation in terms of joint parameters, Direct Kinematics of manipulators, Inverse kinematics of Robot arm for position and orientation. Redundancy in Robots, Static force analysis

UNIT – IV

Introduction to Techniques used in Robot Vision: Image acquisition, illumination techniques, imaging geometry, basic relationship pixels, preprocessing, segmentation & description of 3- dimensional structures, their recognition and interpretation. Types of Camera, frame grabbing, sensing and digitizing image data, Signal conversion, Image Storage, Lighting techniques, Image processing and analysis, Data reduction, Segmentation,

Feature extraction, Object recognition, and various algorithms, Applications, Inspection, identification, visual serving and navigation.

UNIT – V

Robot Programming Languages: Characteristics of robot level languages, task level languages. Teach pendant programming, Lead through programming, Robot programming languages, VAL programming, Motion commands, Sensor commands. End effecter commands, Simple programs. RGV, AGV, Implementation of robots in industries, various steps, Safety considerations for robot operations. Economic analysis of robots, Pay back method, EUAC method and Rate of return method

Suggested readings:

1) Groover M P, **"Industrial Robotics"**, McGraw Hill Publications, 1999.
2) Fu. K.S., Gon Zalez R.C., Lee C.S.G. "**Robotics, Control-sensing vision and Intelligence**", McGraw Hill, Int. Ed., 1987.
3) Spong and Vidyasagar, "**Robot Dynamics & Control**", John Wiley and Sons, Ed.,1990.
4) Mittal and Nagrath, "**Industrial Robotics**", Tata McGraw Hill Publications, 2004.
5) Saha & Subir kumar saha, '**Robotics'**, TMH, India.

Course Code	Course Title						Core / Elective
OE 602 ME	**MATERIAL HANDLING**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- To know about the working principle of various material handling equipments.
- To understand the Material handling relates to the loading, unloading and movement of all types of materials.
- To understand the estimation of storage space and maintenance of material handling equipments.

Course Outcomes

- Able to understand various conveying systems that available in industry.
- Able to understand various bulk solids handling systems and their design features.
- Able to understand and various modern material handling systems and their integration.
- Able to calculate number of MH systems required, storage space, cost and maintenance.

UNIT – I

Mechanical Handling Systems: Belt Conveyors and Desing, Bucket Elevators, Package conveyors, Chain and Flight Conveyors, Screw Conveyors, Vibratory Conveyors, Cranes and Hoists.

UNIT – II

Pneumatic and Hydraulic Conveying Systems: Modes of Conveying and High pressure conveying systems, Low Velocity Conveying System. Components of Pneumatic Conveying Systems: General Requirements, Fans and Blowers, Boots-Type Blowers, Sliding-Vane Rotary Compressors, Screw Compressors, Reciprocating Compressors, Vacuum Pumps.

UNIT – III

Solids Handling: Particle and Bulk Properties- Adhesion, Cohesion and Moisture Content. Gravity Flowof Bulk Solids: Static and Dynamic Pressure Distribution in Bulk Solids. Modes of Flow: Mass Flow, Funnel Flow and Expanded Flow from Hoppers, Bins and Silos.

Unit IV

Modern Material Handling Systems: Constructional features of (i) AGV (ii) automated storage and retrieval systems. Sensors used in AGVs and ASRS.Bar code systems and RFID systems: Fundamentals and their integration with computer-based information systems.

UNIT – V

Total MH Throughput: Calculation for no. of MH systems; storage space estimation based on number of aisles. Maintenance of MH equipment, spare parts management, cost of materials handling, cost per unit load computations

Suggested readings:

1) Dr. Mahesh Varma, "**Construction Equipment and its Planning & Application**", Metropolitan Book Co. (P) Ltd., New Delhi, India, 1997.
2) James M. Apple, **"Material Handling Systems Design",** the Ronald Press Company, New York, USA, 1972.
3) Woodcock CR. and Mason J.S., **"Bulk Solids Handling: An Introduction to Practice Technology**", Leonard Hill USA, Chapman and Hall, New York.
4) M P Groover etal, **"Industrial Robotics**", Me Graw Hill, 1999.

Course Code	Course Title						Core / Elective
OE 632 AE	**AUTOMOTIVE SAFETY AND ERGONOMICS**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives:

It is intended to make the students to

- Understand the basics of vehicle collision and its effects
- Understand the various safety concepts used in passenger cars.
- Gain knowledge about various safeties and its equipment.
- Understand the concepts of vehicle ergonomics.
- Gain knowledge about various automotive comforts features.

Course Outcomes:

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

- Break down the importance of safety in Automobiles
- Describe the various safeties equipment used in Automobiles
- Explain about Vehicle ergonomics and Comforts in Automobiles

UNIT-I

Introduction: Design of the Body for safety, Energy equations, Engine location, Effects of Deceleration inside passenger compartment, Deceleration on impact with stationary and movable obstacle, Concept of Crumble zone and Safety sandwich construction, Active and passive safety, Characteristics of vehicle structures, Optimization of vehicle structures for crash worthiness, Types of crash / roll over tests, Regulatory requirements for crash testing, instrumentation, High speed photography, image analysis.

UNIT-II

Safety Concepts: Active safety- driving safety, Conditional safety, Perceptibility safety and Operating safety, Passive safety: Exterior safety, Interior safety, Deformation behaviour of vehicle body, Speed and acceleration characteristics of passenger compartment on impact, pedestrian safety, human impact tolerance, determination of injury thresholds, severity index, study of comparative tolerance, Study of crash dummies.

UNIT-III

Safety equipments: Seat belt, automatic seat belt fastening system, Collapsible steering column, tilt-able steering wheel, Air bags, electronic systems for activating air bags, Frontal design for safety, collision warning system, Causes of rear end collision, frontal object detection, rear vehicle object detection system, Object detection system with braking system interactions. Anti-lock braking system ESP and EBD systems

UNIT- IV

Vehicle Ergonomics: Introduction to human body - anthropometrics and its application to vehicle ergonomics, Cockpit design, Driver comfort – seating, visibility, Man-machine system- psychological factors – stress, attention, Passenger comfort - ingress and egress, spaciousness, Ventilation, temperature control, Dust and fume prevention and vibration, Interior features and conveniences, Use of modern technology for the same

UNIT-V

Comfort and Convenience System: Cabin comfort - in-car air conditioning – overall energy efficiency, Air management, central and Unitary systems, air flow circuits, air cleaning, ventilation, air space diffusion, Compact heat exchanger design, controls and instrumentation, Steering and mirror adjustment, central locking system, Garage door opening system, tire pressure control system, rain sensor system, environment information system, Automotive lamps, types, design, construction, performance, Light signalling devices- stop lamp, Rear position lamp, Direction indicator, Reverse lamp, reflex reflector, position lamp, gas discharge lamp, LED, Adoptive front lighting system (AFLS) and Daylight running lamps (DRL).

Suggested Reading

1. Prasad, Priya and BelwafaJamel, "Vehicles Crashworthiness and Occupant Protection", American Iron and Steel Institute, USA.
2. JullianHappian-Smith "An Introduction to Modern Vehicle Design" SAE, 2002
3. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000.
4. "Recent development in Automotive Safety Technology", SAE International Publication. Editor: Daniel J Helt, 2013.
5. Keitz H.A.E. "Light Calculations and Measurements", Macmillan 1971.

Course Code	Course Title						Core/Elective
MC 951 SP	**YOGA PRACTICE**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	**20**	**30**	**3U**

Course Objectives:

- Enhances body flexibility
- Achieves mental balance
- Elevates Mind and Body co-ordination
- Precise time management
- Improves positive thinking at the expense of negative thinking

Course Outcomes:

Student will be able to:

- Students will become more focused towards becoming excellent citizens with more and more discipline in their day-to-day life.
- An all-round development-physical, mental and spiritual health-takes place.
- Self-discipline and discipline with respect society enormously increases.
- University environment becomes more peaceful and harmonious.

UNIT-I

Introduction: Yoga definition – Health definition from WHO-Yoga versus Health-Basis of Yoga-yoga is beyond science-Zist of 18 chapters of Bhagavadgita- 4 types of yoga: Karma, Bhakti, Gnyana and Raja yoga–Internal and External yoga-Elements of Ashtanga yoga (Yama, Niyama, Asana, Pranayama, Prathyahara, Dharana, Dhyana and Samadhi)-Panchakoshas and their purification through Asana, Pranayama and Dhyana.

UNIT-II

Surya Namaskaras (Sun Salutations): Definition of sun salutations-7 chakras (Mooladhaar, Swadhishtaan, Manipura, Anahata, Vishuddhi, Agnya and Sahasrar)- Various manthras (Om Mitraya, Om Ravaye, Om Suryaya, Om Bhanave, Om Marichaye, Om Khagaye, Om Pushne, Om Hiranya Garbhaye, Om Adhityaya, Om Savitre, Om Arkhaya and Om Bhaskaraya) and their meaning while performing sun salutations-Physiology-7systems of human anatomy-Significance of performing sun salutations.

UNIT-III

Asan as (Postures): Pathanjali's definition of asana-Sthiram Sukham Asanam-3rdlimbofAshtangayoga-Looseningorwarmingupexercises- Sequence of perform in as an as (Standing, Sitting, Prone, Supine and Inverted)-Nomenclature of as an as (animals, trees, rishis etc)-As an as versus Chakras-As an as versus systems-As an as versus physical health-Activation of Annamaya kosha

UNIT-IV

Pranayama (Breathing Techniques): Definition of Pranayama as per Shankaracharya-4th limb of Ashtanga yoga-Various techniques of breathing-Pranayama techniques versus seasons-Band has and their significance in Pranayama-Mudras and their significance in Pranayama-Restrictions of applying band has with reference to health disorders-Pranayama versus concentration-Pranayama is the bridge between mind and body-Pranayam versus mental health-Activation of Pranamaya kosha through Pranayama.

UNIT-V

Dhyana (Meditation): Definition of meditation-7th limb of Ashtanga yoga- Types of mind (Conscious and Sub-Conscious)-various types of dhyana. Meditation versus spiritual health-Dharana and Dhyana-Extention of Dhyana to Samadhi-Dhyana and mental stress-Activation of Mano mayakosha through dhyana- Silencing the mind

Suggested Reading:

1. Light on Yoga by BKS lyengar
2. Yoga education for children Vol-1 by Swami Satyananda Saraswati
3. Light on Pranayama by BKS lyengar
4. Asana Pranayama Mudra and Bandha by Swami Satyananda Saraswati
5. Hatha Yoga Pradipika by Swami Mukhtibodhananda
6. Yoga education for children Vol-11 by Swami Niranjan an and a Saraswati
7. Dynamics of yoga by Swami Satyananda Saraswati

Course Code	Course Title						Core/Elective
MC 952 SP	**NATIONAL SERVICE SCHEME (NSS)**						**Elective**
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	**25**	**50**	**3U**

Course Objectives:

- To help in Character Molding of students for the benefit of society
- To create awareness among students on various career options in different fields
- To remold the students behavior with assertive skills and positive attitudes
- To aid students in developing skills like communication, personality, writing and soft skills
- To educate students towards importance of national integration, participating in electoral process etc. by making them to participate in observing important days.

Course Outcomes:

Student will be able to:

- Students will become more focused towards becoming excellent citizens with more and more discipline in their day-to-day life.
- An all-round development-physical, mental and spiritual health-takes place.
- Self-discipline and discipline with respect society enormously increases.
- University environment becomes more peaceful and harmonious.

List of Activities:

1. Orientation programme about the role of NSS in societal development
2. Swachh Bharath Programme
3. Guest lecture's from eminent personalities on personality development
4. Plantation of saplings/Haritha Haram Programme 5.BloodDonation / Blood Grouping Camp
5. Imparting computer education to schoolchildren
6. Creating Awareness among students on the importance of Digital transactions
7. Stress management techniques
8. Health Checkup Activities
9. Observation of Important days like voters day, World Water Day etc.
10. Road Safety Awareness Programs
11. Energy Conservation Activities
12. Conducting Programme' son effective communication skills
13. Awareness programme's on national integration
14. Orientation on Improving Entrepreneurial Skills
15. Developing Effective Leadership skills
16. Job opportunity awareness programs in various defence, public sector undertakings
17. Skill Development Programmes
18. Creating awareness among students on the Importance of Yoga and other physical activities
19. Creatingawarenessamongstudentsonvariousgovernmentsponsoredsocialwelfare schemes for the people

Note: At least Ten Activities should be conducted in the Semester**.** Each event conducted under Swachh Barath, Plantation and important days like voters day, world water day may be treated as a separate activity.

Course Code	Course Title						Core/Elective
MC 953 SP	**SPORTS**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	**20**	**30**	**3U**

Course Objectives:

- To develop an understanding of the importance of sport in the pursuit of a healthy and active lifestyle at the College and beyond.
- To develop an appreciation of the concepts of fair play, honest competition and good sportsmanship.
- To develop leadership skills and foster qualities of co-operation, tolerance, consideration, trust and responsibility when faced with group and team problem-solving tasks.
- To develop the capacity to maintain interest in a sport or sports and to persevere in order to achieve success.
- To prepare each student to be able to participate fully in the competitive, recreational and leisure opportunities offered outside the school environment.

Course Outcomes:

Student will be able to:

- Students' sports activities are an essential aspect of university education, one of the most efficient means to develop one's character and personal qualities, promote the fair game principles, and form an active life position.
- Over the past year, sports have become much more popular among our students. Let us remember the most memorable events related to sports and physical training.
- Special attention was paid to team sports. Our male and female games and sports have achieved remarkable progress at a number of competitions.
- Our teams in the main sports took part in regional and national competitions. Special thanks to our team in track and field athletics, which has been revitalized this year at ICT and which has won Javelin competition.
- Staff of our faculties and students of Sports, Physical Development, & Healthy Lifestyle of Faculty congratulates everyone on the upcoming New Year and wishes you robust health and new victories in whatever you conceive.

I. Requirements:

i) Track Pant (students should bring)
ii)Shoes
iii) Volley Ball, Foot Ball and Badminton (Shuttle)
iv) Ground, Court, indoor stadium and swimming pool

II. Evaluation Process:

Total Marks 50
i) 20marks for internal exam (continuous evaluation) a) 8 marks for viva
b) 12marks for sports & fitness

ii) 30marksforendexam a) 10marks for viva
b) 20marks for sports & fitness

Course Code	Course Title						Core/Elective
SI 671 ME	**SUMMER INTERNSHIP**						**Core**
Prerequisite	**L**	**T**	**D**	**P**	**CIE**	**SEE**	**Credits**
-	**0**	**0**	**0**	**2**	**50**	**0**	**2***

Course Objectives: To prepare the students

- To give an experience to the students in solving real life practical problems with all its constraints.
- To give an opportunity to integrate different aspects of learning with reference to real life problems.
- To enhance the confidence of the students while communicating with industry engineers and give an opportunity for useful interaction with them and familiarize with work culture and ethics of the industry.

Course Outcomes: On successful completion of this course student will be

- Able to design/develop a small and simple product in hardware or software.
- Able to complete the task or realize a prespecified target, with limited scope, rather than taking up a complex task and leave it.
- Able to learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to prespecified criteria.
- Able to implement the selected solution and document the same.

Summer Internship is introduced as part of the curricula for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from an Industry / R & D Organization / National Laboratory for a period of 4 weeks. This will be during the summer vacation following the completion of the VI semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide.

After the completion of the project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department. Award of sessional marks are based on the performance of the student at the work place and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will coordinate the overall activity of Summer Internship.

Note: * Students have to undergo summer internship of 4 weeks duration at the end of semester VI and credits will be awarded after evaluation in VII semester.