| Course No. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU202 | ADVANCED THERMODYNAMICS | 3-1-0-4 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To impart knowledge to the students thermodynamic concepts and different power cycles.
- To make the students to solve numerical problems based on laws of thermodynamics and different power cycles.

**Syllabus**

Concepts of thermodynamic systems, Thermometry, first law of thermodynamics, first law for open and closed systems, second law of thermodynamics, concept of entropy, Availability, third law of thermodynamics, Thermodynamic relations, Properties of pure substances, Different power cycles.

**Expected outcome**.

After completing this course the students will be able to

i. explain thermodynamic concepts and different power cycles
ii. solve numerical problems based on laws of thermodynamics and different power cycles.

**Text Book:**

1 P K Nag, *Engineering Thermodynamics*, Tata McGraw Hill Publishing Company Ltd. New Delhi 2008.
2. *Thermal Engineering* by R.K.Rajput, Laxmi publications Ltd.

**Data Book ( Approved for use in the examination):**

**References:**

1. *Thermodynamics an Engineering Approach* by Yunus A Cengel& Michael A Boles
2. *Engineering Thermodynamics* by R.K. Rajput.
3. J. F. Lee and FW Sears, *Engineering Thermodynamics*, Addison-Wesleg Publishing Company, London, 1962.
4. M. A.chuthan, *Engineering Thermodynamics*,Prentice Hall of India Private Ltd,
5. New Delhi 2002.
6. J.P. Holman, *Thermodynamics*, McGraw Hill book company New York, 1988.
7. Mark W. Zemansky, *Heat and Thermodynamic*, McGraw Hill, New Delhi, 2001.
8. Roy T, *Basic Engineering Thermodynamics*, Tata McGraw Hill Publishing Company Ltd. New Delhi 1989.
9. *Thermal Engineering* by Mahesh M Rathore

**Course Plan**

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| I | Fundamentals concepts–scope and limitations of thermodynamics. Thermodynamic systems– different types of systems – macroscopic and microscopic analysis – continuum – Properties– state – processes. Thermodynamics equilibrium – Equation of state of an ideal gas –Real gas relations | 8 | 15% |
| II | Laws of thermodynamics- Zeroth law of thermodynamics – Thermal equilibrium – Concept of temperature – Thermometry –Temperature scales. Work and heat – First | 9 | 15% |

| | | | |
|---|---|---|---|
| | law of thermodynamics– Concept of energy - First law for closed and open systems – Specific heats – internal energy and enthalpy – Steady flow energy equations - Joule Thompson effect. | | |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | Second law of thermodynamics- Various statements and their equivalence_ Reversible process and reversible cycles- Carnot cycles- Corollaries of the second law. Clausius inequality- Concept of entropy – Calculation of change in entropy in various thermodynamic processes – Reversibility and irreversibility – Available and unavailable energy – Third law of thermodynamics. | 9 | 15% |
| **IV** | Thermodynamic relations – Combined first and second law equations – Hemholtz and Gibbs functions – Maxwell relations- Equations for specific heats, internal energy, enthalpy and entropy – Clausius-Clapeyron equations - applications of thermodynamic relations. | 8 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Properties of pure substances – PVT, PT and TS diagrams, Compressibility factor – Law of corresponding states, Mollier diagrams- Mixture of gases and vapours- mixture of ideal gases – Dalton's law – Gibbs law- Thermodynamic properties of mixtures-Numerical problems using steam tables. | 11 | 20% |
| **VI** | Different power cycles- Brayton cycle, reversed Brayton cycle, Lenoir cycle, Stirling cycle, Atkinson cycle, Rankine cycle- Numerical problems based on power cycles. | 11 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Total marks: 100, Time: 3 hours
The question paper shall consist of three parts

**Part A**

4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed.

| Course No. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU204 | CI ENGINES & COMBUSTION | 4-0-0-4 | 2016 |

**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 FI systems in CI engines

**Syllabus**

Diesel fuels, Properties and qualities - Combustion in CI engines, P-θ diagram - Air motion- Squish, tumble - Fuel supply system in diesel engines - Diesel injection pump types - C-AV Bosch pump, Modem distributor type pumps - Diesel filters - Advanced fuel injection system- Unit pump & injector- Common Rail (CR) Fuel Injection Systems - Sensors in CI engine - Pollutants in engines. NOx, CO, unburned hydrocarbons - Exhaust gas treatment.- Catalytic converter – Supercharging - effects of supercharging in S.I and C.I engines - Turbo charging - methods of turbo charging - cold starting devices

**Expected outcome**.

The students will be able to

i. To explain CI Engine and Combustion,
ii. To differentiate and analyse ideal and actual cycles
iii. To diagnose FI systems in CI engines

**Text Book:**

1. M. L. Mathur, R. P. Sharma - Internal Combustion Engines, DhanpatRai Publications
2. R.K. Rajput, Internal Combustion Engines, Laxmi Publications.
3. V Ganesan, *Internal Combustion Engine* Tata McGraw Hill Publishing Company Ltd., New Delhi 2006.

**References:**


1. Newton K, Steeds W and Garrett T.K – Motor Vehicle, Butterworth Heinemann Ltd
2. William H Crouse, Donald L Anglin, Automotive Mechanics , Tata McGraw-Hill Publishers
3. Joseph Heitner- Automobile mechanics, CBS Publishers, New Delhi
4. A.W.Judge, Modern petrol engine, Chapman and Hall, London
5. P. M. Heldt – High speed diesel engines, Chillon Co. New York.
6. Taylor, I.C.Engines, MIT Press, England
7. Lichty , I.C.Engines , McGraw Hill Publishing Co.
8. Smith & Stinson, Fuels & Combustion, McGraw-Hill Publishing Co.
9. John B Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Publishing Company
10. Obert E F,Internal Combustion Engine and air Pollution McGraw Hill book company New York.
11. Sharma S.P, Fuels and Combustion, Tata McGraw Hill Publishing Company Ltd., New Delhi
12. Heinz Heisler, Advanced Engine Technology, Society of Automotive Engineers Inc

## Course Plan

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| I | Diesel fuels, Properties and qualities, Cetane number, alternative fuels for CI engines<br>Combustion in CI engines, P-θ diagram – parameters affecting Ignition delay, uncontrolled combustion, diesel knock - controlling methods. Diesel knock, comparison with SI knock and control.<br>Air motion- Squish, tumble, swirl motions. Different types combustion chambers in CI engines. | 9 | 15% |
| II | Fuel supply system in diesel engines: Requirements of diesel injection system, Components of diesel injection system, Diesel filters, fuel feed pump, hand pump, heavy duty air filters,<br>Diesel injection pump types - simple and multiple unit pump, C-AV Bosch pump, Modem distributor type pumps, injection nozzles and types of injectors, Pump-Line-Injector (PLI) Systems | 8 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Electronic Unit Injectors (EUI) – Advanced fuel injection system- Unit pump & injector- Common Rail (CR) Fuel Injection Systems - Electronic Diesel Control (EDC) - overview & Diagnostics.<br>Sensors in CI engine fuel injection systems – control of fuel injection – Actuators in CRDI systems. | 8 | 15% |
| IV | Thermodynamics of combustion. Combustion reaction of common fuels. Exhaust gas composition. Testing of IC engines - Indicated power – Brake Power - Volumetric efficiency – Heat balance test - Morse test.<br>Gas Exchange Processes - Valve Flow and Volumetric Efficiency - Valve Timing - Dynamic Behavior of Valve Gear.<br>Flue gas analysis using ORSAT apparatus – liquid fuel, gaseous fuel – combustion equations – problems | 9 | 15% |
| | **SECOND INTERNAL EXAMINATION** | | |
| V | Pollutants in engines. NOx, CO, unburned hydrocarbons, smoke and particulate. Sources, causes and measurement of exhaust emission, Non exhaust emissions and control methods, Emission norms<br>Exhaust gas treatment.- Catalytic converter – Thermal reaction -Particulate trap. Flue gas analysis. Air fuel ratio from exhaust gas composition. Numerical problems | 11 | 20% |
| VI | Supercharging: Introduction, Objectives of supercharging, thermodynamic cycle, effects of supercharging in S.I and C.I | 11 | 20% |

| | | | |
|---|---|---|---|
| | engines, performance of the supercharged engine, supercharging limits, and methods of supercharging, superchargers.<br>Turbo charging - methods of turbo charging and its advantages, limitations of turbo charging. Governors (mechanical, pneumatic and hydraulic governors), cold starting devices. | | |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Total marks: 100, Time: 3 hours
The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed.

| Course No. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU206 | AUTO TRANSMISSION | 3-0-0- 3 | 2016 |

**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 design clutch and gearbox.

**Syllabus**

Problems on performance of automobile -Determination of gear ratios for vehicles. Different types of gearboxes -Fluid coupling-Hydrodynamic Torque converter -Construction and operation of Ford – T-model gearbox, Wilson Gear box and electromagnetic transmission-Need for automatic transmission, Principle of operation -Hydrostatic drive -Electric drive-Comparison of hydrostatic drive with hydrodynamic drive-Ward Leonard Control system

**Expected outcome**.

After this course, students will be able to explain about the design of clutches and gear boxes, construction of the transmission components, various types of transmission systems

**Text Book:**

1. 3. Newton and Steeds – "Motor Vehicle"- Illiffee Publisher- 2000.

**References:**

1. Design Practices, passenger Car Automotive Transmissions- SAE Hand book- 1994.

2. Crouse, W.H., Anglin, D.L., Automotive Transmission and Power Trains construction, McGraw Hill, 1992.

3. Heldt, P.M., Torque converters, Chilton Book Co., 1992.

4. Judge, A.W., Modern Transmission systems, Chapman and Hall Ltd., 1990.

5 Heinz Heisler, Modern Vehicle Technology

**Course Plan**

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| I | Problems on performance of automobile - such as resistance to motion, tractive effort, engine speed, engine power and acceleration. Requirement of transmission system, Different types of clutches, principle, Construction and torque capacity. | 6 | 15% |
| II | Determination of gear ratios for vehicles. Different types of gearboxes such as Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox, gear shifting mechanisms in each. | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Construction and operation of Ford – T-model gearbox, Wilson Gear box and electromagnetic transmission. | 6 | 15% |
| IV | Fluid coupling - Principle of operation, Constructional details, Torque capacity, Performance characteristics and Reduction of drag torque. Hydrodynamic Torque converter - Principle of operation, Constructional details and Performance characteristics. Multistage torque converters. | 7 | 15% |

| | | | |
|---|---|---|---|
| | Polyphase torque converters. Converter coupling | | |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Need for automatic transmission, Principle of operation. Hydraulic control system for automatic transmission. Chevrolet "Turboglide" Transmission, Continuously Variable Transmission (CVT) – Types – Operations. | 8 | 20% |
| **VI** | Hydrostatic drive - Various types of hydrostatic systems, Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, Construction and Working of typical Janny hydrostatic drive. Electric drive - Principle of operation of Early and Modified Ward Leonard Control system, Advantages & limitations. | 8 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Total marks: 100, Time: 3 hours

The question paper shall consist of three parts

**Part A**

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed.

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU208 | COMPUTER PROGRAMMING | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To impart knowledge in programming using C language
- To give an overview of the use of C program in Automotive industry

**Syllabus**

Microcontroller modules in Automobile- C in Automotive industry; Introduction to C programming- Data types – keywords – operators; Arrays- Matrix operation – Structure; Functions – Recursion – Macros; Pointers – Memory allocation – storage class; Files– transfer of data in blocks; Introduction to MATLAB; Steps for software development; MISRA C standard.

**Expected outcome**.

After this course students will be able to do simple programs in C language and familiar with the interface.

**Text Book:**

1. Bryon S.Gottfried, *Programming with C Language*.

**References:**

1. Balaguruswamy, *Programming in ANSI C*
2. B.W. Kernigham & Dennis M Ritchie, *C programming language*.
3. Deitel, *How to Program C*

**Course Plan**

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| I | Microcontroller modules in Automobile; Microcontroller programming – high level language, assembly language and machine language; Compiler, assembler and interpreter; Integrated development environment; Chip burning; Use of C in Automotive industry. | 7 | 15% |
| II | Introduction to C programming - Data types; Keywords, Constants and Variables; Escape Sequences; Various I/O functions; Header files; Type casting; Various operators; Precedence of operators; Branching statements; Looping statements; Nested loops; break and continue instructions. | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Arrays; One dimensional arrays; Selection sorting; Binary searching; Various string handling functions; Multidimensional Arrays; Matrix Operations (Addition, Transpose and Multiplication) Sorting of Strings; Structure and Union; Array of Structures. | 7 | 15% |
| IV | Functions; Call by value and call by reference method; Passing One Dimensional and Multidimensional Arrays to a Function; Matrix operations using functions; Recursion; Factorial and Fibonacci series using recursive calls; Macros; Pre-processor directives; Scope of variables. | 7 | 15% |
| | **SECOND INTERNAL EXAMINATION** | | |
| V | Pointers; Pointer to an array; Pointer to a structure; Array of pointers; Pointer to a pointer; Dynamic memory allocation; Reallocation of memory; Self Referential | 7 | 20% |

| | | | |
|---|---|---|---|
| | structure; Stack and heap; Storage class. | | |
| **VI** | Files; Reading, Writing, Appending and rewriting of text and binary files; Transfer of data in blocks, Moving of file pointer in a file; Introduction to MATLAB; Steps for software development; MISRA C standard. | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Total marks: 100, Time: 3 hours

The question paper shall consist of three parts

**Part A**

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed.

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU232 | COMPUTER PROGRAMMINGLAB | 0-0-3-1 | 2016 |

**Prerequisite:** AU208 Computer programming

**Course Objectives**

- To provide experience in programming with C language
- To give exposure to computer softwares like MATLAB.
- To do programming in C covering control structures functions, arrays, structures, pointers and files

**List of Exercises/Experiments :**

1. Checking leap year
2. Finding sum of digits and reverse of a number
3. Generating Prime numbers, Fibonacci numbers and Armstrong numbers
4. Sine and Cosine series generation
5. Counting characters, lines and words
6. Linear search
7. Sorting of numbers and strings
8. Matrix addition, transpose and multiplication
9. Programs using structure and union
10. Programs using functions
11. Programs using recursive calls
12. Programs using macros
13. Programs using pointers
14. Matrix operation using pointers
15. Implementation of dynamic memory allocation
16. Problems related to file reading, writing and appending
17. Transfer of data in blocks
18. Familiarization of MATLAB tool boxes

**Expected outcome**.

After this course students will be able to do simple programs in C language and will be familiar with the interface

**Text Book:**

Bryon S. Gottfried,*Programming with C Language*.

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU234 | VEHICLE SYSTEMS LAB | 0-0-3-1 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To study about hand tools, special purpose tools, and their uses.
- To familiarize with various systems and components of an automobile.
- To know about writing technical specifications and description of all types of chassis and transmission components of automobiles, including body and interiors

**List of Exercises/Experiments (Minimum 12 exercises/experiments are mandatory)**

1. Servicing of clutch assembly, checking the spring tension of coil springs in spring tester.
2. Dismantling of gear box, inspecting components, servicing, checking the gear ratios.
3. Dismantling of differential assembly, servicing, backlash adjustments, check for drive axis ratio.
4. Servicing of A. C. mechanical fuel pump and testing the pump.
5. Servicing of Carburetor, Study Various Circuits on it, tuning of carburetor.
6. Servicing master and wheel cylinders in hydraulic brake system & bleeding of brakes.
7. Valve timing setting including valve clearance adjustment.
8. Servicing of steering gear box, checking for end play in shafts.
9. Overhauling of a complete strut type suspension system.
10. Dismantle and assemble C.V joint. Also examine a slip joint, U.J cross in propeller shaft.
11. Compression test of petrol and diesel engine.
12. Disassembling cylinder head, decarbonizing, Valve Seat Grinding
13. Disassembling of engine: inspection of engine components, servicing of components, measurement of dimensions of different components of engine, compare with standard specifications, piston ring setting, assembling using special tools.
14. Rectifying the troubles in ignition system, adjusting spark plug and C. B. Point gap, checking ignition timing.
15. Cylinder reconditioning: Checking the cylinder bore, setting the tool, re-boring operation using vertical or portable cylinder reboring machine.
16. Tyre removing, inspection, check for cuts, bulges and excessive tread wear, resetting using pneumatic tyre changer & Wheel balancing: Balancing of wheels by computerized wheel balancing machine.
17. Wheel alignment: Checking the camber, caster, king pin inclination, toe in and toe out with computerized wheel alignment machine.
18. F. I. P Calibration and phasing: Setting the angle of fuel delivery, calibration of fuel quantity by FIP calibrating machine.
19. Brake drum re-conditioning: Brake drum skimming after leveling machine, ovality measurement and setting the tool.
20. Testing of Two wheeled vehicles on chassis dynamometer

**Expected outcome**.

After this course the student will be able to

i. handle any maintenance issue in a vehicle
ii. identify the troubles of the vehicles from the symptoms shown.

**Text Book:**


1. Boyce Dwiggins – Automobile Repair guide, Theodor Audel and Co., Indiana – 1978.
2. A. W. Judge – Maintenance of high speed diesel engine, Chapmann Hall Ltd.
3. A. W. Judge – Motor vehicle engine servicing 3rd edition, Pitman paper mark, London, 1969.
4. Vehicle service manuals and reputed manufacturers.

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU302 | AUTOMOTIVE ELECTRICAL AND ELECTRONICS | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To impart knowledge on the principles of operation and constructional details of various Automotive Electrical and Electronic Systems

**Syllabus**

Principle of lead acid battery & constructional details-Charging system-Requirement of starter motor-Battery coil and Magneto ignition system-Electronically assisted ignition system-Lighting-Instrumentation-Sensors and applications in Automobile-Actuators-Electronic fuel injection system overview-Common rail direct injection, Gasoline direct injection, Supercritical injection.

**Expected outcome**.

- The students will become aware of the principles of operation and constructional details of various Automotive Electrical and Electronic Systems like Batteries, Starting System, Charging System, Ignition System, Lighting System and Dashboard Instruments and sensors.

**Text Book:**

1. Tom Denton, "Automobile Electrical and Electronic Systems", Elsevier Butterworth-Heinemann, 2004
2. Kholi .P.L. Automotive Electrical Equipment, Tata McGraw-Hill Co Ltd

**References**

1. Al Santini, Automotive Electricity and Electronics, Cengage Learning, 2013
2. Robert Bosch, Automotive Handbook, Bently Publishers,2004
3. William B. Ribbens , Norman P. Mansour, Understanding automotive electronics, Newnes, 2003
4. Jim Horner, Automotive Electrical HandBook, Penguin, 1986
5. Barry Hollembeak, Automotive Electricity & Electronics, Cengage Learning, 2010

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Principle of lead acid battery & constructional details, Effect of temperature on electrolyte, Capacity Rating, Battery charging methods, Battery tests. Developments in storage: Nickel metal hydride battery, Lithium ion battery, Fuel cells, Ultra capacitors. | 7 | 15% |
| II | Charging system: Working and constructional details of Alternators (single and three phase), Rectification, voltage regulation, current regulation, Charging circuit for 3 phase alternator.<br>Starting system: Requirement of starter motor; Starter Motor types, construction and characteristics, Starter drive mechanisms, Starting circuit, Starter Switches. | 7 | 15% |
| **FIRST INTERNAL EXAMINATION** | | | |

| | | | |
|---|---|---|---|
| **III** | Battery coil and Magneto ignition system, Centrifugal and Vacuum advance mechanisms, Spark plugs, constructional details and types.<br>Electronically assisted ignition system; Non-contact triggering devices - Fully electronic ignition System, Capacitive Discharge Ignition, Distributor-less ignition, Programmed ignition. | 7 | 15% |
| **IV** | Lighting: Types of headlights, headlight reflectors, headlight lenses, indicator lamp details, lighting circuit, projector headlights; Horn and wiper mechanisms.<br>Instrumentation: Speedometer, Fuel Level Indicator, Oil Pressure and Coolant Temperature Indicators, Display devices – LED, LCD,VFD. | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Sensors and applications in Automobile: Pressure sensors, Temperature sensors, Position sensors, Lambda sensor, Air flow sensor, Wheel speed sensor, Knock sensor, Optical sensors.<br>Actuators: Solenoids, Stepper motors, Relays, Piezoelectric. | 7 | 20% |
| **VI** | Electronic fuel injection system overview; D jetronic, K jetronic and L jetronic fuel injection; Injections schemes–Single point, Multi point, Sequential, Direct injection.<br>Common rail direct injection, Gasoline direct injection, Supercritical injection. | 7 | 20% |
| **END SEMESTER EXAM** | | | |

### Question Paper Pattern

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU307 | VEHICLE BODY ENGINEERING | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To impart knowledge on the design of vehicle body to give maximum comfort for the passengers
- To discuss the methods of stream lining vehicle body to minimize drag

**Syllabus**

Classification of coach work types, vehicle aerodynamics, vehicle body design parameters, vehicle body design terms, vehicle ergonomics, body structure types, vehicle stability, and load distribution in vehicles.

**Expected outcome**.

- The students will be able to do vehicle body design giving maximum passenger comfort and producing minimum drag.

**Text Book:**

1. Giles J Pawlowski, Vehicle body engineering Business books limited, 1989
2. Sydney F Page, "Body Engineering"' Chapman & Hall Ltd, London, 1956

**References:**

1. Pope , "Wind tunnel testing" , John Wiley & Sons , 2nd edition, New York, 1974
2. Braithwaite,J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London 1977
3. Dieler Anselm., The passenger car body, SAE International, 2000
4. Giles,G.J., Body construction and design, Illiffe Books Butterworth & Co., 1971.
5. John Fenton, "Vehicle body layout and analysis", Mechanical Engg. Publication ltd, London.
6. Paul Browne – Auto care manual.
7. Redesign of bus bodies – Part 1 and Part 2 C. I. R. T., Pune.

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Classification of coachwork type: styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, commercial vehicle types, Vans and Pickups. Terms used in body building construction - Angle of approach, Angle of departure, Ground clearance, Cross bearers, Floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets.<br>Basic dimension: Regulations as per ARAI, driver's seat, passengers seat, visibility. | 7 | 15% |
| II | Aerodynamics: Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles Interior Ergonomics: Introduction, ergonomics system design, Seating dimensions ,seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. | 7 | 15% |

| | | | |
|---|---|---|---|
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | Vehicle Body Materials: Aluminium alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention | 7 | 15% |
| **IV** | Load distribution: Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation for static, symmetrical, longitudinal & side loads, stress analysis of bus body structure under bending and torsion. Vehicle Stability: Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Noise and vibration: Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression<br>Safety: Impact protection basics, Physics of impact between deformable bodies, Design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety. | 7 | 20% |
| **VI** | Introduction to CFD technology, fluidic design considerations, effect of air dams on front bumpers, effect of projected accessories on body, wind tunnel testing of car body, parameters considered for wind tunnel testing, introduction to software simulation of car body structures.<br>Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU332 | AUTO ELECTRICAL & ELECTRONICS LAB | 0-0-3-1 | 2016 |

**Prerequisite :** AU302 Automotive electrical and electronics

**Course Objectives**

- To familiarize the design and construction of various automotive electrical systems.

**List of Exercises/Experiments :** (Minimum 12 experiments are mandatory)

*Testing of batteries*

1. Hydrometer test with temperature correction
2. Heavy load test and open voltage test

*Familiarization of charging system*

3. Familiarizing different stator and rotor types, analyzing AC output waveform
4. Single phase rectifiers and three phase bridge rectifier
5. Testing of regulators and cut out relays
6. Constructing a working model of charging system

*Familiarization of starting system*

7. Speed and torque characteristics of DC motors
8. Testing different starter drive mechanisms
9. Constructing a working model of starting system

*Familiarization of ignition system*

10. Assembling of battery/coil ignition system
11. Assembling of magneto ignition system
12. Constructing a working model of programmed ignition system with electronic triggering
13. Design and construct a working model of lighting circuit with components given
14. Design and construct a working model of wiper system with components given
15. Demonstration of dash board panel instruments and controls
16. Design and construct a working model of power window system with components given
17. Design and construct a working model of power steering with components given

**Expected outcome**.

The students will be able to

i. design and construct various automotive electrical systems
ii. do fault finding and rectification of automotive electrical systems.

**List of Equipments**

- Battery hydrometer, Voltmeter/ Multimeter
- Electronics components for rectifier circuit, Alternator, Dynamo, Automotive regulator and cut out relays, Digital Storage Oscilloscope
- DC motors, Starter drive mechanisms
- Battery ignition system, Magneto ignition system, Microcontroller, Sensors for ignition timing ( CPS, Camshaft sensor, MAP, MAF, Temperature sensor etc.)
- Automotive Lighting system
- Dashboard module
- Power window system
- Power steering system

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU361 | ALTERNATIVE FUELS AND ENERGY SOURCES | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To impart the basic concepts of energy and its sources.
- To develop a clear understanding about the alternative fuels for I.C engines.

**Syllabus**

Introduction- Types of energy sources, Alcohols for SI and CI Engines- Vegetable oil as diesel fuels, Hydrogen energy & Fuel Cells, CNG- LNG- Biogas- Wind Energy, Solar power- Collection and storage of solar energy, Electric vehicles- Design considerations- limitations- opportunities for improvement

**Expected outcome**.

i. The students will understand the energy conversion, utilization and storage for renewable technologies.
ii. The students will be familiar with the potential of using renewable energy technologies as a complement to the extent possible, replacement for conventional technologies and the possibility of combining renewable and non-renewable energy technologies in hybrid systems.
iii. To understand the environmental aspects of energy usage and conversion

**Text Book**:

1. Jack Erjavec, Alternative fuels, Cengage publications
2. Mathur & Sharma, IC engines, Dhanpat Rai publications

**References:**


1. T. K. Garrett, Automotive fuels system, SAE INC, Warrendale, 1991
2. Keeith Owen & Trevor Colley, Automotive Fuels reference book, SAE
3. Richard L. Bechtold, Alternate fuels guide book, SAE
4. Energy research group, Alternate liquid fuels, Willey Eastern Ltd
5. Nagpal , Power Plant Engineering, Khanna Publishers
6. G.D Rai, Solar energy utilization, Khanna Publishers, 2004
7. Dr.N.K.Giri, Automobile technology, Khanna publications


**Course Plan**

| Module | Contents | Hours | Sem Exam Marks |
|---|---|---|---|
| I | **Introduction**<br>Types of energy sources - conventional and non-conventional energy and their availability. Scenario of conventional automobile fuels, need for alternative energy sources.<br>I.C engine fuel ratings- octane number, cetane number, diesel index, fuel properties, additives, fuel quality aspects related to emissions. Implementation barriers for alternative fuels | 7 | 10% |
| II | **Bio fuels for SI and CI Engines**<br>***Alcohols for SI engines***- manufacture of methanol, manufacture of ethanol, comparison of properties of alcohols and gasoline as SI engine fuels, engine performance with pure alcohols, alcohol | 7 | 20% |

| | | | |
|---|---|---|---|
| | gasoline fuel blends-gasohol- E85.<br>***Vegetable oils as diesel fuels*** - vegetable oils as diesel fuels, straight vegetable oils and bio-diesels, performance properties of engines with bio-diesel, Ethers of alcohols. | | |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | **Hydrogen energy & Fuel Cells**<br>Properties of hydrogen, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo – chemical production and biochemical production, storage and methods, applications to engines, modifications necessary, hazards and safety systems for hydrogen , performance characteristics in engines. Emissions from hydrogen fuel engines.<br>Fuel cell - working, advantages and limitations. | 7 | 20% |
| **IV** | **CNG, LNG, Biogas, Wind Energy** Gaseous fuels: Availability of CNG, LNG, properties, modification required to use CNG in engines. Production of Biogas, application of bio-gas as a single fuel and dual fuel.<br>Basics of Wind Energy, current and future technologies; Wind turbine and its components. | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | **Solar power**<br>Collection and storage of solar energy, collection devices, flat plate collectors, concentrating type collectors, storage methods, principle and working of photovoltaic conversion, application to automobiles. | 7 | 15% |
| **VI** | **Electric vehicles**<br>Design considerations, limitations, opportunities for improvement, applicability of electric cars, cost of electric cars, types of motors. Batteries- types, capacities, limitations, future possibilities. | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU362 | HYBRID AND FUEL CELL VEHICLES | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To provide an overview about the hybrid and fuel cell vehicles.

**Syllabus**

Introduction to hybrid electric vehicles, Hybrid Electric Drive-trains, Electric Propulsion unit, Configuration and control of various motor drives, Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Sizing the drive system, Selecting the energy storage technology, Communications, supporting subsystems; Fuel cell characteristics- fuel cell types, Fuel cell electric vehicles; Short Term Storage Systems: Flywheel Accumulators, Ultra capacitors, Superconducting magnetic energy storage; Hydraulic Accumulators; Hydraulic Pumps/Motors - Pneumatic Hybrid Engine Systems. Energy management strategies used in hybrid vehicles.

**Expected outcome**.

- The students will get an idea of the present scenario about hybrid vehicles in the context of energy conservation and pollution control.

**Text Book:**

1. Iqbal Hussein, *"Electric and Hybrid Vehicles: Design Fundamentals"*, CRC Press, 2003.

**References**

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, *"Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design"*, CRC Press, 2004.
2. Mike Westbrook, *"The Electric Car: Development & Future of Battery- Hybrid & Fuel Cell Cars"*, British library Cataloguing in Publication Data.
3. John M. Miller, "*Propulsion System for Hybrid Vehicle*", The Institution of Engineers, London, UK, 2004.
4. James Larminie, John Lowry – Electric vehicle technology explained – John Wiley

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Introduction to hybrid electric vehicles: components, advantages and disadvantages, application, social and environmental impacts. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies. | 7 | 15% |
| II | Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of PMDC Motor drives, Configuration and control of BLDC Motor drives, Configuration and control of Induction Motor drives. | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy | 7 | 15% |

| | | | |
|---|---|---|---|
| | storage devices. | | |
| **IV** | Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Fuel cell characteristics, fuel cell types: alkaline fuel cell. Proton exchange Membrane; direct methanol fuel cell. Phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, hydrogen storage systems - reformers; Fuel cell vehicles. | 7 | 20% |
| **VI** | Short Term Storage Systems: Flywheel Accumulators, Ultra capacitors, Superconducting magnetic energy storage; Hydraulic Accumulators; Hydraulic Pumps/Motors - Pneumatic Hybrid Engine Systems. Energy management strategies used in hybrid and electric vehicles: types, comparison and implementation issues | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P –Credits | Year of Introduction |
|---|---|---|---|
| AU401 | AUTOMOTIVE SYSTEM DESIGN | 4-0-0-4 | 2016 |

**Prerequisite:** ME307 Machine design I

**Course Objectives**

- To impart the design aspects of various automotive system components

**Syllabus**

Basic Definitions and Terminologies, design parameters for multi-cylinder engine, design of valve gear, design of engine structure, design of lubricating system elements, design of cooling system components, design of speed gear boxes

**Expected outcome**.

- The students will be able to design basic components of automotive systems

**References**


1. A. Kolchin and V. Demidov ,Design of automotive engines, , Mir Publishers, Moscow
2. N K Giri, Automobile Mechanics (through problems), Khanna Publishers
3. P. M. Heldt , High speed combustion engines-design-production- test, Oxford and IBH Co. Pvt. Ltd.


**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | **Basic Definitions and Terminologies:** Air resistance-rolling resistance-total resistance, vehicle speed-driving force-excess driving force-driving horse power-brake horse power-indicated horse power- indicated mean effective pressure- frictional mean effective pressure- frictional horse power- indicated horse power- mechanical efficiency- brake torque. Simple numerical problems for familiarization with the definitions. | 9 | 15% |
| II | **Design parameters for multi-cylinder engine:** Assumptions made for design- body dimensions-engine dimensions-valve timing angles- performance parameters (maximum power, maximum torque, acceleration), calculation for mechanical efficiency and brake torque based on the definitions-terminologies and assumptions, plotting of performance curves based on the calculations, Turning moment calculation for each cylinder-net load on piston- side thrust-combined turning moment. | 10 | 15% |
| **FIRST INTERNAL EXAMINATION** | | | |
| III | **Design of valve gear-** Introduction-main dimensions of passage sections in the throat and valve-main dimensions of intake cam-shaping of convex cam and harmonic cam with flat follower- the time section of valve-design of valve spring. | 9 | 15% |
| IV | **Design of Engine Structure**-Cylinder block and upper crankcase-cylinder liners-cylinder block head-cylinder studs, **Design of lubricating system elements**-Oil pump-centrifugal oil filter-oil cooler-Design of bearings | 9 | 15% |

| SECOND INTERNAL EXAMINATION | | | |
|---|---|---|---|
| **V** | **Design of cooling system components-**Introduction-Water pump design (petrol engines and diesel engines)-Radiator (petrol engines and diesel engines)-Cooling fan(petrol engines and diesel engines) | 9 | 20% |
| **VI** | **Design of speed gear boxes**, standardization of spindle speeds, speed diagrams, design of housings, lubrication considerations | 10 | 20% |
| **END SEMESTER EXAM** | | | |



## Question Paper Pattern

Maximum marks: 100, Time: 3 hrs

The question paper should consist of three parts

**Part A**
3 questions uniformly covering modules I and II. Each question carries 15 marks
Students will have to answer any two questions out of 3 (2X15 marks =30 marks)

**Part B**
3 questions uniformly covering modules III and IV. Each question carries 15 marks
Students will have to answer any two questions out of 3 (2X15 marks =30 marks)

**Part C**
3 questions uniformly covering modules V and VI. Each question carries 20 marks
Students will have to answer any two questions out of 3 (2X20 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU402 | TWO AND THREE WHEELERS | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To understand the constructional details operating characteristics and vehicle design aspects.

**Syllabus**

The power unit- two and four stroke, fuel and ignition system, transmission systems-clutches-gear box, chassis and sub systems-frames-suspension, brakes and wheels, two and three wheeler-case study.

**Expected outcome**.

- The students will acquire two and three wheeler technology and latest developments in the industry.

**Text Book:**

- Irving. P. E., Motor cycle Engineering, Temple Press Book, London, 1992.

**References**


1. Bryaut. R. V., Vespa maintenance and repair service.
2. Encyclopedia of Motor cycling, 20 volumes, Marshall Cavensih, New York and London, 1989.
3. K.K. Ramalingam, Two Wheelers, Scitech publications, Chennai.
4. Raymond Broad, Lambretta- A practical guide to maintenance and repair, 1987.
5. The Cycle Motor Manual. Temple Press Ltd., London, 1990.


**Course Plan**

| Module | Contents | Hours | End Sem. Exam Marks |
|---|---|---|---|
| I | **The power plant**<br>Two stroke and four stroke SI and CI engine construction and working, merits and demerits, symmetrical and unsymmetrical valve and port timing diagrams, scavenging process. | 7 | 15% |
| II | **Fuel and ignition system**<br>Fuel system- Different circuits in two wheeler fuel systems, fuel injection system, lubrication system<br>Ignition systems- magneto coil and battery coil spark ignition system, electronic ignition system, starting system- kick starter system-self starter system, recent technologies | 7 | 15% |
| **FIRST INTERNAL EXAMINATION** | | | |
| III | **Transmission system**<br>Clutches- single- multi plate and centrifugal clutches, Gear box and its various gear controls in two wheelers. | 7 | 15% |
| IV | **Chassis and sub-systems**<br>Main frame for two and three wheelers. Its types, chassis and different drive systems for two wheelers<br>Front and rear suspension systems-shock absorbers, panel meters and controls on handle bar, freewheeling devices | 7 | 15% |

| SECOND INTERNAL EXAMINATION | | | |
|---|---|---|---|
| **V** | **Brakes and wheels**<br>Drum brakes and disc brakes-construction- working and types, front and rear brake link lay outs, brake actuation mechanism, spokes wheel, cast wheel, disc wheel and its merits and demerits<br>Tyres and tubes construction and types, steering geometry | 8 | 20% |
| **VI** | **Two and three wheelers- case study**<br>Case study of sports bike, motor cycles, scooters and mopeds-auto rickshaws, pick up van, delivery van and trailer, servicing and maintenance, recent developments | 6 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P –Credits | Year of Introduction |
|---|---|---|---|
| AU403 | VEHICLE DYNAMICS | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To familiarize the students with vibrating systems
- To understand the characteristics of the tires.
- To know about the stability and handling characteristics of vehicles at different tracks.

**Syllabus**

Stability of vehicles-Braking requirements-Road Loads-Over steer, under steer, steady state cornering-Suspension-Tires-Performance of road vehicles-Classification of vibration-aerodynamic forces

**Expected outcome**.

- The students will be able to solve simple design problems based on the vehicle stability and various design parameter based problems.

**Text Book:**

1. Giri N.K, Automobile Mechanics, 8/e, Khanna Publishers
2. Rao V. Dukkipati, Jian Pang, "Road Vehicle Dynamics problems and solution", SAE, 2010

**References**

1. David Corolla, 'Automotive Engineering', 'Powertrain, chassis system and Vehicle Body', Butterworth Heinmann, 2009
2. G. Giles, 'Steering, Suspension and Tires, Illiffe Books Ltd., 1968.
3. J. Y. Wong, 'Theory of Ground Vehicles', John Wiley and Sons Inc., New York
4. JazarR N, Vehicle Dynamics, Springer Verlag, New York, 2014
5. W. Steeds, Mechanics of road vehicles, Wildlife book Ltd, London 1990.

**Course Plan**

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| I | Classification of vibration, Specification and Vibration, Vibration System and human comforts, Modal Analysis, One DOF, Two DOF, Free and Forced Vibration, Damped Vibration, Magnification and Transmissibility, Vibration Absorber.<br>Performance of road vehicles: Tractive resistance, tractive effort, power required for propulsion, grade ability, drawbar pull and the problems related to these terms.<br>Road performance curves- acceleration, gradability and drawbar pull, acceleration time and Elasticity. | 7 | 15% |
| II | Tires: tire dynamics Ride characteristics, Behavior while Cornering, Slip angle, Cornering force, Power consumed by Tire, Oversteer, under steer, steady state cornering, aligning moment-combined braking and Cornering, effect of camber & transient effects in cornering. Tire vibrations | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Suspension: Vehicle dynamics and suspension | 7 | 15% |

| | | | |
|---|---|---|---|
| | requirements, choice of suspension spring rate, chassis springs and theory of chassis springs, Gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system, Roll axis and the vehicle under the action of side forces. | | |
| **IV** | Stability of vehicles: Load distribution (Three wheeled and four wheeled vehicles), Calculation of acceleration, tractive effort and reactions for different drives, stability of a vehicle on a curved track, slope and a banked road. Gyroscopic effects, weight transfer during acceleration, Cornering and braking, stability of a rigid vehicle and equations of motion of a rigid vehicle, cross wind handling. | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering. Effect of camber, transient effects in cornering. Directional stability of vehicles. Braking requirements, stopping distance, braking efficiency, work done in braking, tire adhesion. | 7 | 20% |
| **VI** | Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100, Time: 3 hrs

The question paper should consist of three parts

**Part A**
3 questions uniformly covering modules I and II. Each question carries 15 marks
Students will have to answer any two questions out of 3 (2X15 marks =30 marks)

**Part B**
3 questions uniformly covering modules III and IV. Each question carries 15 marks
Students will have to answer any two questions out of 3 (2X15 marks =30 marks)

**Part C**
3 questions uniformly covering modules V and VI. Each question carries 20 marks
Students will have to answer any two questions out of 3 (2X20 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU404 | ENGINE AND VEHICLE MANAGEMENT SYSTEMS | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To understand the principles of various electronic systems in engine and vehicle management systems.

**Syllabus**

Open and closed loop control system, P, PI and PID control, ECUs in an Automobile, Electronic engine control, Engine performance variables and its control strategies; Electronic fuel control, Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Electronic ignition control, Electronic control transmission, GPS navigation, On Board Diagnostics (OBD).Cruise control system, Anti-lock braking system, Traction control system, Electronic brake force distribution, Electronic stability program. Airbags, Collision avoidance radar warning system, Tyre pressure monitoring, Lane departure warning system, Night vision system

**Expected outcome** .

- The students will be able to explain the principles of various electronic engine and vehicle management systems

**Text Book:**

William B Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Butterworth-Heinermann, 7th edition, 2012

**References:**


1. Eric Chowanietz, "Automobile Electronics" SAE Publications, 1994
2. Konrad Reif (Ed.), Bosch Professional Automotive Information, Diesel Engine management Systems and Components, Springer Verlag, 2014
3. Konrad Reif (Ed.), Bosch Professional Automotive Information, Gasoline Engine management Systems and Components, Springer Verlag, 2015
4. Robert Bosch, "Automotive Hand Book", SAE (8th Edition), 2011.
5. Steve V. Hatch, "Computerised engine controls", Cengage Learning, 2012
6. Tom Denton, "Automobile Electrical and Electronic Systems" 4th edition, Routledge, 2012


**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Open and closed loop control system, P, PI and PID control, ECUs in an Automobile, Microcomputers in Control system, look up tables, Introduction to modern control strategies like Fuzzy logic and adaptive control | 7 | 15% |
| II | Electronic engine control – input and output, Engine performance variables and its control strategies, Engine mapping<br>Effect of Air/Fuel ratio on performance, Effect of spark timing on performance, Effect of EGR on performance, exhaust control | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Electronic fuel control, engine control sequence, open loop and closed control, cold starting, acceleration and full load | 7 | 15% |

| | | | |
|---|---|---|---|
| | enrichment, deceleration leaning, overrun fuel cut off, Idle speed control and EGR control | | |
| **IV** | Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronic ignition control, Ignition timing map, Ignition timing calculation (Initial timing, Basic advance angle, Corrective advance angle), spark advance correction scheme. | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Electronic control transmission: control of shift timing, control of lock up, neutral to drive squat control, engine torque control.<br>Dual clutch automatic, Automated manual transmission, Continuously variable transmission.<br>GPS navigation and On Board Diagnostics (OBD). | 7 | 20% |
| **VI** | Cruise control system, Anti-lock braking system, Traction control system, Electronic brake force distribution, Electronic stability program.<br>Airbags, Collision avoidance radar warning system, Tyre pressure monitoring, Lane departure warning system, Night vision system | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU405 | AUTOMOTIVE REFRIGERATION AND AIR CONDITIONING | 3-0-0-3 | 2016 |

**Prerequisite: Nil**

**Course Objectives**

- To impart knowledge about refrigeration and air conditioning systems, components, control and service.
- To understand the procedure for refrigeration and air conditioning load calculation.

**Syllabus**

Principles of refrigeration, Air conditioning systems, load on refrigeration & air conditioning systems, air distribution systems, air routing and temperature control, air conditioning control, air conditioning service.

**Expected outcome**.

- The students will be able to do refrigeration and air conditioning load calculation.

**Text Books:**

1. Steven Daly , Automotive Air conditioning and Climate Control Systems, Butterworth-Heinemann, USA
2. V Paul Lang , Principles of Air Conditioning by, CBS Publishers and Distributors Pvt.Ltd

**References**

1. C.P.Arora, Refrigeration and Air conditioning, Tata McGraw Hill Publications
2. Dossat., Principles of Refrigeration, John Wiley and Sons
3. Robert H. Enerick, Basic Refrigeration and Air-Conditioning, Prentice Hall of India Ltd.
4. Stoecker W.F. and Jones J.W, Refrigeration and Air-Conditioning, McGraw- Hill
5. Jordan and Priester, Refrigeration and Air-Conditioning, Prentice Hall of India.
6. R.K.Rajput , Refrigeration and Air conditioning. Kataria publishers
7. R.S. Khurmi and J.S Gupta , Refrigeration and Air conditioning, S Chand Company

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Principles of refrigeration: Thermodynamics of refrigeration – Carnot, reversed Carnot cycle, heat pump, and refrigerator-coefficient of performance -unit of refrigeration. Refrigeration methods-conventional refrigeration systems. Air refrigeration system –Bell Coleman cycle -C.O.P –capacity, types of refrigerants. | 7 | 20% |
| II | Air Conditioning Systems Classification, layouts, central, unitary air conditioning systems, components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems, Automotive heaters, Types, Heater Systems, Air conditioning protection, Engine protection. | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Load Analysis: Outside & inside design consideration, factors forming the load on refrigeration & air conditioning systems, | 7 | 20% |

| | | | |
|---|---|---|---|
| | procedure for cooling & heating load calculation in automobiles, effect of air conditioning load on engine performance. | | |
| **IV** | Air Distribution Systems**:** Distribution duct system, sizing, supply *I* return ducts, type of grills, diffusers, ventilation, air noise level, layout of duct systems for automobiles. | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Air Routing & Temperature Control: Objectives, evaporator air flow, through the recirculating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control of air handling systems<br>Air Conditioning Control: Common control such *as* thermostats, humidistat, control dampers, pressure cut outs, relays | 7 | 20% |
| **VI** | Air conditioning service**:** Air conditioner maintenance & service-causes of air conditioner failure, leak testing guide, discharging the system.<br>Evacuating the system, charging the system, servicing heater system, removing & replacing components, trouble shooting of air conditioning system, compressor service, methods of dehydration, charging & testing. | 7 | 10% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU407 | ADVANCED IC ENGINES | 3-0-0-3 | 2016 |

**Prerequisite: NIL**

**Course Objectives**

- To impart the basic concepts of non-conventional IC Engines
- To know the new concepts of automotive engine combustion technologies
- To discuss about future engine technologies

**Syllabus**

Types of engines -Dual fuel engine concepts and significance-Multi fuel engines-Lean burn engines - Gas turbine plants -Stratified charge combustion in direct injection SI engines -HCCI and CAI engines

**Expected outcome**.

- The students will become aware of the latest developments and advancement in the field of IC engines.

**Text Books:**

1. H Zhao, Advanced Direct Injection Combustion Engine Technologies and Development, volume 1- gasoline and gas engines, Wood head publishing, 2009
2. H Zhao, Advanced Direct Injection Combustion Engine Technologies and Development, volume 2- diesel engines, Wood head publishing, 2009

**Reference books**

3. H Zhao , HCCI and CAI Engines for the Automotive Industry ,Woodhead publishing
4. Derek Dunn -Rankin, Lean Combustion: Technology and Control , Academic press, 2007
5. M. L. Mathur, R. P. Sharma - Internal Combustion Engines, Dhanpat Rai Publications
6. V Ganesan, *Internal Combustion Engine* Tata Mc Graw Hill Publishing Company Ltd., New Delhi 2006.

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Types of engines - Wankel engine - Stirling engine - free piston engine. – light duty DI diesel engines (HSDI), high pressure pump technology, multiple injection diesel combustion | 7 | 15% |
| II | Dual fuel engine concepts and significance, factors affecting combustion in dual fuel engines, performance of dual fuel engines. Multi fuel engines, characteristics of multi fuel engines, performance of multi fuel engines. Concept and working of flexi fuel vehicles (FFV). | 7 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Lean burn engines – fundamentals of lean combustion – burning in flames – auto ignitive burning – flame stabilization – lean burn SI engines – engine combustion and emissions – lean limit operations | 8 | 20% |
| IV | Gas turbine plants – Open and closed cycles – thermodynamic cycles – regeneration – re heating – inter cooling – efficiency and performance of gas turbines – Gas turbine as automotive engine – | 6 | 10% |

| | | | |
|---|---|---|---|
| | Limitations of gas turbine in automotive sector. Comparison of gas turbine Vs. I.C engine. Condition for perfect reheating and inter cooling. simple problems | | |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Stratified charge combustion in direct injection SI engines – thermodynamic and combustion process – production engines with stratification – future trends – Turbo charged direct injection SI engines – problems and challenges – advantages – future trends<br>Direct injection gasoline engines with auto ignition combustion – principles and approaches – operation and control – development of practical engines – future trends. Direct injection natural gas engines – technologies – potential applications – strength and weakness – future trends | 7 | 20% |
| **VI** | HCCI and CAI engines – fundamentals – effect of use of exhaust gas dilution – approaches to CAI/HCCI – Two stroke CAI engines – principles – control – potential applications – four stroke gasoline and diesel HCCI engines – HCCI fuel requirements – low temperature and premixed combustion with late injection – NADI concept of HCCI –CAI control and CAI/SI switching | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU409 | SIMULATION AND ANALYSIS OF IC ENGINE PROCESSES | 3-0-0-3 | 2016 |

**Prerequisite : AU201 & AU202**

**Course Objectives**

- To provide an outline of the simulation methods adopted for IC Engine processes

**Syllabus**

Heat of reaction at constant volume and constant pressure - Constant volume and constant - pressure adiabatic combustion - Adiabatic flame temperature - Simulation of SI Engine Combustion - working substance under full and part throttle conditions - CI engine simulation with adiabatic combustion - supercharged and turbocharged conditions - flow through valves - Mach index - Effect of valve timing - Swirl and squish - scavenging parameters - delivery ratio - trapping efficiency - two stroke engine simulation - Engine friction variation, models for engine friction - Heat transfer mechanisms in engines

**Expected outcome**.

- The students will be to simulate processes in SI & CI engines

**Text Books:**

1. V.Ganesan, Computer simulation of compression ignition engine processes, Universities Press
2. V Ganesan Computer simulation of Spark Ignition Engine Processes, Universities Press

**References**

3. Richard Stone, Introduction to Internal Combustion Engines, SAE Inc., 1999
4. Colin R Ferguson , Internal Combustion Engines – Applied Thermo Sciences, John Wiley and Sons.
5. John B Heywood , Internal Combustion Engine Fundamentals, , McGraw Hill

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Combustion Calculations: Heat of reaction at constant volume and constant pressure, Calculation of properties of the working medium in an engine, Constant volume and constant pressure adiabatic combustion, Calculation of Adiabatic flame temperature. | 8 | 15% |
| II | Simulation of SI Engine Combustion: Engine kinematics, Ideal Otto cycle, SI engine simulation with adiabatic combustion with air as the working substance under full and part throttle conditions. Actual SI engine heat release rate curves. | 7 | 20% |
| **FIRST INTERNAL EXAMINATION** | | | |

| | | | |
|---|---|---|---|
| **III** | Simulation of CI Engine Combustion: CI engine simulation with adiabatic combustion with air as the working substance under naturally aspirated, supercharged and turbocharged conditions. Zero dimensional combustion models for CI engines | 7 | 20% |
| **IV** | Gas Exchange Processes: Flow through valves their characteristics, compressible and incompressible flow through valves, volumetric efficiency and Mach index, Effect of valve timing on volumetric efficiency, Swirl and squish, SI engine simulation with gas exchange, influence of valve timing and area. | 7 | 20% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Two stroke engine scavenging parameters like delivery ratio, scavenging efficiency, trapping efficiency. Perfect displacement and perfect mixing models for scavenging. Port diagrams and two stroke engine simulation | 7 | 15% |
| **VI** | Heat Transfer and Friction in Engines: Engine friction variation, models for engine friction, Heat transfer mechanisms in engines, Models for heat transfer in engines. | 6 | 10% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| AU431 | AUTOTRONICS LAB | 0-0-3-1 | 2016 |

**Prerequisite :** AU302 Automotive Electrical and Electronics

**Course Objectives**

- Familiarize the students with the various sensors used in Automobiles.
- Impart knowledge in designing electronic circuits in automotive systems.

**List of Experiments/Exercises** (Minimum 12 are mandatory)

*Testing of electronic components and basic electronic circuits used in automobiles*

1. Testing of various sensors used in automobiles
2. Diodes, Transistor, Op-amps, Relays
3. Amplifier using op-amp

*Familiarization of digital electronics*

4. Testing of logic gate ICs.
5. Testing of flip flops.

*Microcontroller/Microprocessor programming and interfacing (8085/PIC/Arduino)*

6. Implement simple programs (arithmetic operations/logic functions)
7. Interfacing various sensors like RTD, LVDT, load cell etc.
8. Interfacing seven segment displays.
9. Interfacing of stepper motor
10. Interfacing of dc motor
11. Interfacing ADC for data acquisition and DAC for control application.
12. On-board diagnostics ( OBD) and fault detection
13. Familiarization of engine remapping tools and software
14. Design and testing of circuit for electronic ignition triggering
15. Design and testing of the circuit for keyless entry, parking system.
16. Design and testing of the circuits for ABS, Cruise Control.

**Expected outcome**.

- The students will have hands-on-experience in auto electrical systems and fault diagnostics.

**List of Equipments needed**

- CPS, MAF, MAP, ECT, IAT, Lambda sensor, Knock sensor etc.
- Diodes, Transistors, Op-amp, Relays
- Logic gates, Flip flops
- Microcontrollers (PIC/8085/ Arduino)
- Seven segments displays, Stepper motors, DC motors
- Interface cards, ADC, DAC
- OBD scanners and softwares
- Electronic triggering devices (Hall Effect sensor, Pickup coil, Optical)
- RF transceivers, Proximity sensors
- ABS modules and actuators, RADAR modules

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU462 | VEHICLE MAINTENANCE | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To impart knowledge on maintenance of vehicles to give maximum life for vehicles
- To identify various troubles occurred for the vehicles from the symptoms shown.

**Syllabus**

Maintenance schedule, importance of maintenance, repair of chassis, repair of various drive train components, engine overhauling, auxiliary systems repair, introduction to the maintenance of new generation vehicles, introduction to on board diagnostics.

**Expected outcome**.

- The students will be able to identify the troubles of the vehicles from the symptoms shown.

**Text Book:**

1. A W. Judge, Maintenance of high speed diesel engine, Chapmann Hall Ltd.
2. Boyce Dwiggins , Automobile Repair guide, Theodor Audel and Co., Indiana, 1978.

**References**

1. A. W. Judge – Motor vehicle engine servicing 3rd edition, Pitman paper mark, London, 1969.
2. Vehicle service manuals of reputed manufacturers.
3. William B Ribbens – Understanding automotive electronics , Newnes, 2003

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Maintenance, Records and schedules: Importance of maintenance, types of maintenance, inspection, schedule, maintenance, log sheets, servicing, requirements of service station, layout and personnel for service station. | 7 | 15% |
| II | Maintenance and repair of chassis: Servicing of clutch assembly, gearbox and propeller shaft, troubles and trouble shooting on transmission, differential maintenance and repair, backlash adjustment, servicing of braking system, identification and rectification of brake faults, brake testing steering system, maintenance, tyre rotation, tyre retreading, checking and adjusting, suspension, wheel balancing, wheel alignment. | 7 | 15% |
| **FIRST INTERNAL EXAMINATION** | | | |
| III | Engine overhauling and repair: Reconditioning of engine, specific tools used for overhauling, de-carbonizing and degreasing, engine tune up, valve reconditioning, use of automobile stethoscope, troubles and troubleshooting related to engines. | 7 | 15% |
| IV | Vehicle body repair and maintenance, minor panel beating, dolly blocks, tinkering, body painting, maintenance of body trim, specific tools for body repair, methods of towing a vehicle.and disadvantages. | 7 | 15% |

| SECOND INTERNAL EXAMINATION | | | |
|---|---|---|---|
| **V** | Maintenance of auxiliaries: Maintenance of starter motor and dynamo or alternator, battery maintenance, methods of testing various electrical accessories and other accessories, radiator service, anticorrosion additives, engine oil change, preventive maintenance. | 7 | 20% |
| **VI** | Introduction to maintenance of new generation vehicles- On board Diagnostics- software tools used for the error diagnostics in new generation vehicles- common types of sensor errors- procedure of on board diagnostics. | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| AU463 | OPERATION MANAGEMENT IN AUTO INDUSTRY | 3-0-0-3 | 2016 |

**Course Objectives**

- To introduce the basic concepts of automotive industry
- To impart the basic concepts of plant operation and management
- To discuss automotive marketing and supply chain limits

**Syllabus**

Strategic planning of production activities -Manufacturing engineering planning -Labour efficiency analysis – manpower planning -Plant manufacturing system -Equipments – general service, -Logistics – evolution -Role of purchasing department -Quality management

**Expected outcome**.

- The students will be able to apply management principles in automotive industry and various management related affairs used in automotive industry

**Text Books:**

1. Marco Gobetto, Operation management in automotive industries, Springer, 2013

**Reference books**

1. David Edwards, Gary Holt, Frank Harris, Maintenance Management of Heavy Duty Construction Plant and Equipment, Chandos publication
2. Joseph Berk, Susan Berk Quality Management for the Technology Sector, Butterworth-Heinemann publication
3. R B Chase & F R Jacobs , Operations Management for Competitive Advantage, McGraw Hill

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Strategic planning of production activities – process integration – 'make or buy' decision making – manufacturing system setup – location criteria – overview of technology in construction – sketches of manufacturing systems.<br>Standardization logic & project setup – process description – information technology systems – product composition analysis – management of technical changes. | 7 | 10% |
| II | Manufacturing engineering planning – executive project – working time analysis methodologies – man-machine interaction – standard working time – equipment utilization analysis – operation productivity – machine loading – installed productive capacity<br>Labour efficiency analysis – man power planning – working time length o labour productivity improvement – task assigning – workload balancing – motivating employees | 7 | 20% |
| **FIRST INTERNAL EXAMINATION** | | | |

| | | | |
|---|---|---|---|
| **III** | Plant manufacturing system – reliability & maintainability – autonomous and professional maintenance – correlation between cost and maintenance – breakdown and preventive maintenance activity volume<br>Equipments – general service, co-generation & auxiliary equipments – energy consumption optimization – tools and consumable management – TPM approach | 7 | 15% |
| **IV** | Logistics – evolution – flow in supply chain – material handling – inventory management methodologies – production and delivery planning – logistics information systems | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Performance indicators of logistics – finished product inventory, process lead time, flow index, risk indicators, lead time, service level – JIT approach | 7 | 20% |
| **VI** | Role of purchasing department – purchasing policies – management of supplier network – order procedure – supplying cost – purchase effectiveness – e-procurement Quality management – product design phase – TQM – continuous improvement approach – kaizen and kanban systems. | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed

# BE102 DESIGN AND ENGINEERING

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| BE102 | DESIGN AND ENGINEERING | 2-0-2-3 | 2015 |

**Course Objectives**

The purpose of this course is:-

1. To excite the student on creative design and its significance;
2. To make the student aware of the processes involved in design;
3. To make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design;
4. To get an exposure as to how to engineer a design.

**Syllabus**

Design and its objectives; Role of science, engineering and technology in design; Engineering as a business proposition; Creative design and the Design Process; Design evaluation and communication of designs; Design for function and strength; Material selection and design detailing; Role of standards in design Engineering the design; Design for "X"; Product centered and user centered design; Aesthetics and ergonomics; Concepts of value engineering, concurrent engineering and reverse engineering in design; Culture based design; Modular design; Design optimization needs; User interface; Intelligent and autonomous products; Internet of things; Advanced products and human psychology; Life cycle design; Product and its environment; Design as a marketing tool; Products and IPR; Product liability.

**Expected outcome**

The student will be:-

1. Able to appreciate the different elements involved in good designs and to apply them in practice when called for.
2. Aware of the product oriented and user oriented aspects that make the design a success.
3. Will be capable to think of innovative designs incorporating different segments of knowledge gained in the course;
4. Students will have a broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis.

**References Books**:


- Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27], ISBN13: 978-0124158917 ISBN-10: 0124158919
- Dym, C. L., Little, P. and Orwin, E. J., Engineering Design - A Project based introduction - Wiley, ISBN-978-1-118-32458-5
- Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, XI, 489 p. ISBN 978-94-011-3985-4 Springer
- Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning, ISBN-13: 978-0-495-66816-9
- Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., Engineering Design: A Systematic Approach, 3rd ed. 2007, XXI, 617p., ISBN 978-1-84628-319-2
- Voland, G., Engineering by Design, ISBN 978-93-325-3505-3, Pearson India


**Web pages:**

1. E-Book (Free download): http://opim.wharton.upenn.edu/~ulrich/designbook.html
2. http://www2.warwick.ac.uk/fac/sci/wmg/ftmsc/modules/modulelist/peuss/designforx/design_for_x_notes_section_5.pdf

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Design and its objectives; Design constraints, Design functions, Design means and Design from; Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. Design form, function and strength; | L2 | 15% |
| | How to initiate creative designs? Initiating the thinking process for designing a product of daily use. Need identification; Problem Statement; Market survey-customer requirements; Design attributes and objectives; Ideation; Brain storming approaches; arriving at solutions; Closing on to the Design needs. | L3 | |
| | An Exercise in the process of design initiation. A simple problem is to be taken up to examine different solutions-Ceiling fan? Group Presentation and discussion. | P4 | |

| | | | |
|---|---|---|---|
| **II** | Design process- Different stages in design and their significance; Defining the design space; Analogies and "thinking outside of the box"; Quality function deployment-meeting what the customer wants;<br>Evaluation and choosing of a design. | L2 | 15% |
| | Design Communication; Realization of the concept into a configuration, drawing and model. Concept of "Complex is Simple". Design for function and strength.<br>Design detailing- Material selection, Design visualisation- Solid modelling; Detailed 2D drawings; Tolerancing; Use of standard items in design; Research needs in design; Energy needs of the design, both in its realization and in the applications. | L3 | |
| | An exercise in the detailed design of two products (Stapler/ door/clock) | P4 | |
| **FIRST INTERNAL EXAM** | | | |
| **III** | Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis. | L2 | 15% |
| | Engineering the design – From prototype to product. Planning; Scheduling; Supply chains; inventory; handling; | L3 | |
| | manufacturing/construction operations; storage; packaging; shipping; marketing; feed-back on design. | | |
| | List out the standards organizations.<br>Prepare a list of standard items used in any engineering specialization.<br>Develop any design with over 50% standard items as parts. | P4 | |
| **IV** | Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc.<br>List out the design requirements(x) for designing a rocket shell of 3 meter diameter and 8 meter length. | L4 | 15% |
| | Design mineral water bottles that could be packed compactly for transportation. | P4 | |
| **SECOND INTERNAL EXAM** | | | |
| **V** | Product centred and user centred design. Product centred attributes and user centred attributes. Bringing the two closer. Example: Smart phone. Aesthetics and ergonomics. | L2 | 20% |

| | | | |
|---|---|---|---|
| | Value engineering, Concurrent engineering, Reverse engineering in design; Culture based design; Architectural designs; Motifs and cultural background; Tradition and design;<br>Study the evolution of Wet grinders; Printed motifs; Role of colours in design. | L4 | |
| | Make sharp corners and change them to smooth curves-check the acceptance. Examine the possibility of value addition for an existing product. | P6 | |
| **VI** | Modular design; Design optimization; Intelligent and autonomous products; User interfaces; communication between products; autonomous products; internet of things; human psychology and the advanced products. Design as a marketing tool; Intellectual Property rights – Trade secret; patent; copy-right; trademarks; product liability. | L3 | 20% |
| | Group presentation of any such products covering all aspects that could make or mar it. | P6 | |
| **END SEMESTER EXAM** | | | |

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| BE103 | INTRODUCTION TO SUSTAINABLE ENGINEERING | 2-0-1-3 | 2016 |

**Course Objectives**

- To have an increased awareness among students on issues in areas of sustainability
- To understand the role of engineering and technology within sustainable development;
- To know the methods, tools, and incentives for sustainable product-service system development
- To establish a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.

**Syllabus**

Sustainability- need and concept, challenges, Environment acts and protocols, Global, Regional and Local environmental issues, Natural resources and their pollution, Carbon credits, Zero waste concept ISO 14000, Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Technology and sustainable development, Sustainable urbanization, Industrial Ecology.

**Expected outcome**

The student will be

- Able to understand the different types of environmental pollution problems and their sustainable solutions
- Able to work in the area of sustainability for research and education
- Having a broader perspective in thinking for sustainable practices by utilizing the engineering knowledge and principles gained from this course

**Reference Books**:


- Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
- Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
- Environment Impact Assessment Guidelines, Notification of Government of India, 2006
- Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
- ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
- Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
- Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).

- Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act. | L4 | 15% |
| | Students may be assigned to do at least one project eg:<br>a) Identifying/assessment of sustainability in your neighbourhood in education, housing, water resources, energy resources, food supplies, land use, environmental protection etc.<br>b) Identify the threats for sustainability in any selected area and explore solutions for the same | P1 | |
| II | Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concept, 3 R concept. Global environmental issues- Resource degradation, Climate change, Global warming, Ozone layer depletion, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print. | L6 | 15% |
| | Students may be assigned to do at least one project for eg:<br>a) Assessing the pollution status of a small area<br>b) Programmes for enhancing public environmental awareness<br>c) Observe a pond nearby and think about the different measures that can be adopted for its conservation | P3 | |
| | **FIRST INTERNAL EXAM** | | |
| III | Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking, Environment Impact Assessment (EIA) - Procedures of EIA in India. | L4 | 15% |
| | Students may be assigned to do at least one project eg:<br>a) Conducting LCA of products (eg. Aluminium cans, PVC bottles, cars etc. or activities (Comparison of land filling and open burning)<br>b) Conducting an EIA study of a small project (eg. Construction of a building) | P2 | |

| | | | |
|---|---|---|---|
| **IV** | Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings. Sustainable cities, Sustainable transport. | L5 | 15% |
| | Students may be assigned to do at least one project eg:<br>a) Consider the design aspects of a sustainable building for your campus<br>b) Explore the different methods that can be adopted for maintaining a sustainable transport system in your city. | P2 | |
| | **SECOND INTERNAL EXAM** | | |
| V | Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. | L5 | 20% |
| | Students may be assigned to do at least one project eg:<br>a) Find out the energy savings that can be achieved by the installation of a solar water heater<br>b) Conduct a feasibility study for the installation of wind mills in Kerala | P2 | |
| **VI** | Green Engineering, Sustainable Urbanisation, industrialisation and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis. | L5 | 20% |
| | Students may be assigned to do a group project eg:<br>a) Collect details for instances of climate change in your locality<br>b) Find out the carbon credits you can gain by using a sustainable transport system (travelling in a cycle or car pooling from college to home)<br>c) Have a debate on the topics like: Industrial Ecology is a Boon or Bane for Industries?/Are we scaring the people on Climate Change unnecessarily?/Technology enables Development sustainable or the root cause of unsustainability? | P3 | |
| | **END SEMESTER EXAM** | | |

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| CE230 | MATERIAL TESTING LAB | 0-0-3-1 | 2016 |

**Course Objectives:**

1. To provide knowledge on mechanical behaviour of materials
2. To acquaint with the experimental methods to determine the mechanical properties of materials.

**Syllabus**

**List of experiments:**

1. Tension test on mild steel/ tor-steel/ high strength steel and cast iron using Universal Testing Machine and extensometers.
2. Tests on springs (Open and closed coiled)
3. Torsion pendulum (mild steel, aluminium and brass wires)
4. Hardness test (Brinell, Vickers and Rockwell)
5. Impact test (Izod and Charpy)
6. Torsion test on mild steel rods.
7. Shear test on mild steel rods.
8. Fatigue test – Study of testing machine.
9. Bending test on wooden beams.
10. Strut test (Column buckling experiment)
11. Verification of Clerk Maxwell's law of reciprocal deflection and determination of Young's modulus of steel.
12. Photo elastic methods for stress measurements.
13. Jominy hardenability test
14. Measurement using strain gauges
15. Determination of moment of inertia of rotating bodies

Note: A minimum of 10 experiments are mandatory.

**Expected outcome:** At the end of the course the students will be able to

1. Acquire the knowledge on mechanical behaviour of materials
2. Conduct experiments determine the mechanical properties of materials.

**References Books**:


1. G E Dieter. Mechanical Metallurgy, McGraw Hill,2013
2. Dally J W, Railey W P, Experimental Stress analysis , McGarw Hill,1991
3. Baldev Raj, Jayakumar T, Thavasimuthu M., Practical Non destructive testing, Narosa Book Distributors,2015

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| EE110 | ELECTRICAL ENGINEERING WORKSHOP | 0-0-2-1 | 2016 |

**Course Objectives**

The objective of this course is to familiarize the students with commonly used components, accessories and measuring equipment in Electrical installations. The course also provides hands on experience in setting up of simple wiring circuits.

**List of Exercises / Experiments (Minimum of 8 mandatory)**

1. Identify different types of cables/wires and switches and their uses.
2. Identify different types of fuses & fuse carriers, MCB and ELCB, MCCB with ratings and usage.
3. Wiring of simple light circuit for controlling light/fan point (PVC conduit wiring).
4. Wiring of light/fan circuit using Two way switches (Staircase wiring)
5. Wiring of fluorescent lamps and light sockets (6 A)
6. Wiring of Power circuit for controlling power device (16A socket)
7. Godown wiring / Tunnel wiring
8. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, Main switch and Energy meter.
9. Measurement of voltage, current and power in single phase circuit using voltmeter, ammeter and wattmeter. Calculate the power factor of the circuit.
10. Wiring of backup power supply including inverter, battery and load for domestic installations.
11. Demonstration and measurement of power consumption of electric iron, mixer grinder, single phase pump, exhaust fan, etc.
12. Energy meter reading and tariff calculation

**Expected outcome**

1. Familiarity with supply arrangements and their limitations, knowledge of standard voltages and their tolerances, safety aspects of electrical systems and importance of protective measures in wiring systems.
2. Knowledge about the types of wires, cables and other accessories used in wiring. Creating awareness of energy conservation in electrical systems.
3. Students should be able to wire simple lighting circuits for domestic buildings, distinguish between light and power circuits.
4. To measure electrical circuit parameters and current, voltage and power in a circuit.
5. Familiarity with backup power supply in domestic installation.

| Course code. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| EE311 | ELECTRICAL DRIVES & CONTROL FOR AUTOMATION | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

1. To understand the basic concepts of different types of electrical machines and their performance.
2. To know the different methods of starting D.C motors and induction motors.
3. To introduce the controllers for automation

.

**Syllabus**

DC Machines, transformers, three phase induction motor, single phase induction motor, stepper motor, controllers for automation.

**Expected outcome** .

The students will be able to

1. Select a drive for a particular application based on power rating.
2. Select a drive based on mechanical characteristics for a particular drive application.
3. Discuss the controllers used for automation

**Text Books:**


1. Kothari D. P. and I. J. Nagrath, Electrical Machines, Tata McGraw Hill, 2004.
2. Nagrath .I.J. & Kothari .D.P, Electrical Machines, Tata McGraw-Hill, 1998
3. Richard Crowder, Electrical Drives and Electromechanical systems, Elsevier, 2013
4. Mehta V. K. and R. Mehta, Principles of Electrical and Electronics, S. Chand & Company Ltd., 1996.
5. Theraja B. L. and A. K. Theraja, A Text Book of Electrical Technology, S. Chand & Company Ltd., 2008.
6. Vedam Subrahmaniam, Electric Drives (concepts and applications), Tata McGraw- Hill, 2001


**References:**


1. H.Partab, Art and Science and Utilisation of electrical energy, Dhanpat Rai and Sons, 1994
2. M. D.Singh, K. B. Khanchandani, Power Electronics, Tata McGraw-Hill, 1998
3. Pillai.S,K A first course on Electric drives, Wiley Eastern Limited, 1998


**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | DC Machines-principle of operation-emf equation-types of excitations. Separately excited, shunt and series excited DC generators, compound generators. General idea of armature reaction, OCC and load characteristics - simple numerical problems. | 6 | 15% |
| II | Principles of DC motors-torque and speed equations-torque speed characteristics- variations of speed, torque and power with motor current. Applications of dc shunt series and compound motors. Principles of starting, losses and efficiency – load test- simple numerical problems. | 6 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Transformers – principles of operations – emf equation- vector | 7 | 15% |

| | | | |
|---|---|---|---|
| | diagrams- losses and efficiency – OC and SC tests. Equivalent circuits- efficiency calculations- maximum efficiency – all day efficiency – simple numerical problems. Auto transformers constant voltage transformer- instrument transformers. | | |
| **IV** | Three phase induction motors- slip ring and squirrel cage types- principles of operation – rotating magnetic field- torque slip characteristics- no load and blocked rotor tests. Circle diagrams- methods of starting – direct online – auto transformer starting | 7 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Single phase motors- principle of operation of single phase induction motor – split phase motor – capacitor start motor- stepper motor- universal motor Synchronous machines types – emf equation of alternator – regulation of alternator by emf method. Principles of operation of synchronous motors- methods of starting- V curves- synchronous condenser | 8 | 20% |
| **VI** | Stepper motors: Principle of operation, multistack variable reluctance motors, single-stack variable reluctance motors, Hybrid stepper motors, Linear stepper motor, comparison, Torque-speed characteristics, control of stepper motors<br>Controllers for automation, servo control, Digital controllers, Advanced control systems, Digital signal processors, motor controllers, Axis controllers, Machine tool controllers, Programmable Logic Controllers | 8 | 20% |
| **END SEMESTER EXAM** | | | |

## QUESTION PAPER PATTERN:

**Maximum marks: 100** **Time: 3 hrs**

The question paper should consist of three parts

**Part A**

There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: in all parts each question can have a maximum of four sub questions

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| HS300 | Principles of Management | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To develop ability to critically analyse and evaluate a variety of management practices in the contemporary context;
- To understand and apply a variety of management and organisational theories in practice;
- To be able to mirror existing practices or to generate their own innovative management competencies, required for today's complex and global workplace;
- To be able to critically reflect on ethical theories and social responsibility ideologies to create sustainable organisations.

**Syllabus**

Definition, roles and functions of a manager, management and its science and art perspectives, management challenges and the concepts like, competitive advantage, entrepreneurship and innovation. Early contributors and their contributions to the field of management. Corporate Social Responsibility. Planning, Organizing, Staffing and HRD functions, Leading and Controlling. Decision making under certainty, uncertainty and risk, creative process and innovation involved in decision making.

**Expected outcome**.

A student who has undergone this course would be able to

i. manage people and organisations
ii. critically analyse and evaluate management theories and practices
iii. plan and make decisions for organisations
iv. do staffing and related HRD functions

**Text Book:**

Harold Koontz and Heinz Weihrich, *Essentials of Management*, McGraw Hill Companies, 10th Edition.

**References:**

1. Daft, *New era Management*, 11th Edition, Cengage Learning
2. Griffin, *Management Principles and Applications*, 10th Edition, Cengage Learning
3. Heinz Weirich, Mark V Cannice and Harold Koontz, *Management: a Global, Innovative and Entrepreneurial Perspective*, McGraw Hill Education, 14th Edition
4. Peter F Drucker, *The Practice of Management*, McGraw Hill, New York
5. Robbins and Coulter, *Management*, 13th Edition, 2016, Pearson Education

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Introduction to Management: definitions, managerial roles and functions; Science or Art perspectives- External environment-global, innovative and entrepreneurial perspectives of Management (3 Hrs.)– Managing people and organizations in the context of New Era- Managing for competitive advantage - the Challenges of Management (3 Hrs.) | 6 | 15% |

| | | | |
|---|---|---|---|
| **II** | **Early Contributions and Ethics in Management**: Scientific Management- contributions of Taylor, Gilbreths, Human Relations approach-contributions of Mayo, McGregor's Theory, Ouchi's Theory Z (3 Hrs.) Systems Approach, the Contingency Approach, the Mckinsey 7-S Framework Corporate Social responsibility- Managerial Ethics. (3 Hrs) | 6 | 15% |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | **Planning:** Nature and importance of planning, -types of plans (3 Hrs.)- Steps in planning, Levels of planning - The Planning Process. – MBO (3 Hrs.). | 6 | 15% |
| **IV** | **Organising for decision making:** Nature of organizing, organization levels and span of control in management Organisational design and structure –departmentation, line and staff concepts (3 Hrs.) Limitations of decision making- Evaluation and selecting from alternatives- programmed and non programmed decisions - decision under certainty, uncertainty and risk-creative process and innovation (3 Hrs.) | 6 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | **Staffing and related HRD Functions:** definition, Empowerment, staff – delegation, decentralization and recentralisation of authority – Effective Organizing and culture-responsive organizations –Global and entrepreneurial organizing (3 Hrs.) Manager inventory chart-matching person with the job-system approach to selection (3 Hrs.) Job design-skills and personal characteristics needed in managers-selection process, techniques and instruments (3 Hrs.) | 9 | 20% |
| **VI** | **Leading and Controlling:** Leading Vs Managing – Trait approach and Contingency approaches to leadership - Dimensions of Leadership (3 Hrs.) - Leadership Behavior and styles – Transactional and Transformational Leadership (3 Hrs.) Basic control process- control as a feedback system – Feed Forward Control – Requirements for effective control – control techniques – Overall controls and preventive controls – Global controlling (3 Hrs.) | 9 | 20% |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Max. marks: 100, Time: 3 hours .
The question paper shall consist of three parts

**Part A:** 4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)
**Part B :** 4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)
**Part C:** 6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed.

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| CE100 | BASICS OF CIVIL ENGINEERING | 2-1-0-3 | 2016 |

**Course Objectives**

1. To inculcate the essentials of Civil Engineering field to the students of all branches of Engineering.
2. To provide the students an illustration of the significance of the Civil Engineering Profession in satisfying societal needs.

**Syllabus**

General introduction to Civil Engineering - Introduction to types of buildings, Components of a residential building, Introduction to industrial buildings; Introduction to planning of residential buildings - Simple building plans; Introduction to the various building area terms; Setting out of a building; Surveying – Principles, Objectives, Horizontal measurements with tapes, Ranging; Levelling – Instruments, Reduction of levels; Modern surveying instruments; Building materials – Bricks, cement blocks, Cement, Cement mortar, Steel; Building construction – Foundations, Brick masonry, Roofs, Floors, Decorative finishes, Plastering, Paints and Painting; Basic infrastructure and services – Elevators, Escalators, Ramps, Air conditioning, Sound proofing, Towers, Chimneys, Water Tanks; Intelligent buildings.

**Expected outcome**

1. The students will be able to illustrate the fundamental aspects of Civil Engineering.
2. The students will be able to plan and set out a building.
3. Students will be able to explain the concepts of surveying for making horizontal and vertical measurements.
4. They will able to illustrate the uses of various building materials and explain the method of construction of different components of a building.
5. Students will be able to discuss about various services in a building.

**References Books**:


- Chudley, R., Construction Technology, Vol. I to IV, Longman Group, England
- Chudley, R. and Greeno, R., Building Construction Handbook, Addison Wesley, Longman Group, England
- Gopi, S., Basic Civil Engineering, Pearson Publishers
- Kandya, A. A., Elements of Civil Engineering, Charotar Publishing house
- Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers

- McKay, W. B. and McKay, J. K., Building Construction Volumes 1 to 4, Pearson India Education Services
- Minu, S., Basic Civil Engineering, Karunya Publications
- Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
- Rangwala, S. C. and Dalal, K. B., Engineering Materials, Charotar Publishing house
- Rangwala, S. C. and Dalal, K. B., Building Construction, Charotar Publishing house


**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | General Introduction to Civil Engineering - Various disciplines of Civil engineering, Relevance of Civil engineering in the overall infrastructural development of the country. | 2 | 15% |
| | Introduction to types of buildings as per NBC; Selection of site for buildings. | 2 | |
| | Components of a residential building and their functions. Introduction to industrial buildings – office / factory / software development office / power house /electronic equipment service centre (any one related to the branch of study) | 2 | |
| | Students have to visit one such building and submit an assignment about the features of any one of the listed building related to their branch (Not included for exam). | 1 | |
| II | Building planning - Introduction to planning of residential buildings- Site plan, Orientation of a building, Open space requirements, Position of doors and windows, Size of rooms; Preparation of a scaled sketch of the plan of a single storeyed residential building in a given site plan. | 4 | 15% |
| | Introduction to the various building area terms - Computation of plinth area / built up area, Floor area / carpet area - for a simple single storeyed building; Setting out of a building. | 3 | |
| | **FIRST INTERNAL EXAM** | | |
| III | Surveying - Principles and objectives of surveying; | 1 | 15% |
| | Horizontal measurements – instruments used – tape, types of tapes; Ranging (direct ranging only) – instruments used for ranging. | 3 | |
| | Levelling - Definitions, principles, Instruments (brief discussion only) - Level field book - Reduction of levels - problems on levelling (height of collimation only). | 3 | |
| | Modern surveying instruments – Electronic distance meter, digital level, total station, GPS (Brief discussion only). | 1 | |
| IV | Building materials - Bricks, cement blocks - Properties and specifications. | 2 | 15% |

| | | | |
|---|---|---|---|
| | Cement – OPC, properties, grades; other types of cement and its uses (in brief). | 1 | |
| | Cement mortar – constituents, preparation. | 1 | |
| | Concrete – PCC and RCC – grades. | 1 | |
| | Steel - Use of steel in building construction, types and market forms. | 1 | |
| **SECOND INTERNAL EXAM** | | | |
| **V** | Building construction – Foundations; Bearing capacity of soil (definition only); Functions of foundations, Types - shallow and deep (sketches only). | 2 | 20% |
| | Brick masonry – header and stretcher bond, English bonds – Elevation and plan (one brick thick walls only). | 2 | |
| | Roofs – functions, types, roofing materials (brief discussion only). | 1 | |
| | Floors – functions, types; flooring materials (brief discussion only). | 1 | |
| | Decorative finishes – Plastering – Purpose, procedure. | 1 | |
| | Paints and Painting – Purpose, types, preparation of surfaces for painting (brief discussion only). | 2 | |
| **VI** | Basic infrastructure and services - Elevators, escalators, ramps, air conditioning, sound proofing (Civil engineering aspects only) | 2 | 20% |
| | Towers, Chimneys, Water tanks (brief discussion only). | 1 | |
| | Concept of intelligent buildings. | 2 | |
| **END SEMESTER EXAM** | | | |

| Course No: | Course Name | L-T-P Credits | Year of Introduction |
|---|---|---|---|
| EC100 | BASICS OF ELECTRONICS ENGINEERING | 2-1-0-3 | 2016 |

**Course Objectives**

1) To get basic idea about types, specification and common values of passive and active components.
2) To familiarize the working of diodes, transistors, MOSFETS and integrated circuits.
3) To understand the working of rectifiers, amplifiers and oscillators.
4) To get a basic idea about measuring instruments
5) To get a fundamental idea of basic communication systems and entertainment electronics

**Syllabus**

Evolution and Impact of Electronics in industries and in society, Familiarization of Resistors, Capacitors, Inductors, Transformers and Electro mechanical components, PN Junction diode: Structure, Principle of operation, Zener diode, Photo diode, LED, Solar cell, Bipolar Junction Transistors: Structure, Principle of operation, characteristics, Rectifiers and power supplies: Half wave and full wave rectifier, capacitor filter, zener voltage regulator, Amplifiers and Oscillators: common emitter amplifier, feedback, oscillators, RC phase shift oscillator, Analogue Integrated circuits: operational amplifier, inverting and non-inverting amplifier, Electronic Instrumentation: digital multimeter, digital storage oscilloscope, function generator, Radio communication: principle of AM & FM, Super heterodyne receiver, Satellite communication: geo-stationary satellite system, Mobile communication: cellular communications, Optical communication: system, principle of light transmission through fiber, Entertainment Electronics: Cable TV, CCTV system.

**Expected Outcome**

Student can identify the active and passive electronic components. Student can setup simple circuits using diodes and transistors. Student will get fundamental idea about basic communication systems and entertainment electronics.

**Text Books:**

- Bell, D. A., Electronic Devices and Circuits, Oxford University Press
- Tomasy, W., Advanced Electronic Communication system, PHI Publishers

**References Books**:

- Boylested, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education
- Frenzel, L. E., Principles of Electronic Communication Systems, Mc Graw Hill
- Kennedy, G. and Davis, B., Electronic Communication Systems, Mc Graw Hill

| | | | |
|---|---|---|---|
| • Rajendra Prasad, Fundamentals of Electronic Engineering, Cengage Learning | | | |
| **Course Plan** | | | |
| **Module** | **Contents** | **Hours** | **Sem. Marks** |
| **I** | Evolution of Electronics, Impact of Electronics in industry and in society. | 1 | 10% |
| | Resistors, Capacitors: types, specifications. Standard values, marking, colour coding. | 3 | |
| | Inductors and Transformers: types, specifications, Principle of working. | 2 | |
| | Electro mechanical components: relays and contactors. | 1 | |
| **II** | PN Junction diode: Intrinsic and extrinsic semiconductors, Principle of operation, V-I characteristics, principle of working of Zener diode, Photo diode, LED and Solar cell. | 4 | 20% |
| | Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, input and output characteristics of common emitter configuration (npn only). | 3 | |
| **FIRST INTERNAL EXAM** | | | |
| **III** | Rectifiers and power supplies: Block diagram description of a dc power supply ,Half wave and full wave (including bridge) rectifier, capacitor filter, working of simple zener voltage regulator. | 4 | 15% |
| | Amplifiers and Oscillators: Circuit diagram and working of common emitter amplifier, Block diagram of Public Address system, concepts of feedback, working principles of oscillators, circuit diagram & working of RC phase shift oscillator. | 4 | |
| **IV** | Analogue Integrated circuits: Functional block diagram of operational amplifier, ideal operational amplifier, inverting and non-inverting Amplifier. | 3 | 15% |
| | Digital ICs: Logic Gates. | 1 | |
| | Electronic Instrumentation: Principle and block diagram of digital multimeter, digital storage | 2 | |

| | | | |
|---|---|---|---|
| | oscilloscope, and function generator. | | |
| **SECOND INTERNAL EXAM** | | | |
| **V** | Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver. | 3 | 20% |
| | Satellite communication: concept of geo-stationary Satellite system. | 2 | |
| **VI** | Mobile communication: basic principles of cellular communications, concepts of cells, frequency reuse. | 2 | 20% |
| | Optical communication: block diagram of the optical communication system, principle of light transmission through fiber, advantages of optical communication systems. | 2 | |
| | Entertainment Electronics Technology: Basic principles and block diagram of cable TV, CCTV, DTH system. | 2 | |
| **END SEMESTER EXAM** | | | |

Note: Analysis is not required in this course.

| Course No: | Course Name | L-T-P Credits | Year of Introduction |
|---|---|---|---|
| BE101-02 | INTRODUCTION TO MECHANICAL ENGINEERING SCIENCES | 2-1-0-3 | 2016 |

**Course Objectives**

1. To introduce different disciplines of Mechanical Engineering
2. To kindle interest in Mechanical Engineering
3. To impart basic mechanical engineering principles

**Syllabus**

Thermodynamics & Power sources, Thermal Engineering, Refrigeration and Air Conditioning, Automobile & Aeronautical Engineering, Engineering Materials and manufacturing.

**Expected Outcome**

At the end of the course, the students will have exposed to the different areas of Mechanical Engineering; gained idea about nature, scope and applications of Mechanical Engineering principles.

**References Books**:


- Dossat, R. J., Principles of Refrigeration, PHI
- Heywood, J., Internal Combustion Engine Fundamentals, McGraw Hill Publishers
- Holman, J. P., Thermodynamics, McGraw Hill Co.
- Jain, K. K. and Asthana, R. B., Automobile Engineering, TTTI Bhopal
- Jonathan Wickert, Introduction to Mechanical Engineering, Cengage Learning
- Kalpakjian, S. and Schmid, S. R., Manufacturing Processes for Engineering Materials, Pearson education
- Maines, R., Landmarks in Mechanical Engineering, ASME
- Peng, W. W., Principles of Turbomachinery, John Wiley & Sons
- Pita, E. G., Air Conditioning Principles & Systems, PHI.
- Spalding, D. B. and Cole, E. H., Engineering Thermodynamics, ELBS & Edward Arnold (Pub) Ltd.
- Stone, R. and Ball, T. K., Automotive Engineering Fundamentals, SAE International
- Sutton, G. P. and Ross, D. M., Rocket Propulsion Elements, John Wiley & Sons
- Von Karman, T., Aerodynamics: Selected Topics in the Light of Their Historical Development, Courier Corporation
- Online course on Refrigeration & Air conditioning, IIT Kharagpur www.nptel.ac.in

| Course Plan | | | |
|---|---|---|---|
| **Module** | **Contents** | **Hours** | **Sem. Exam Marks** |
| I | **Thermodynamics**: Nature and scope of thermodynamics; Basic concepts ; Laws of thermodynamics- Discovery, Significance & Applications; Qualitative ideas on Entropy, Available energy, Irreversibility, Principle of increase of entropy & Carnot engine; Limitations of Thermodynamics; Sources of power; history of power production; power production in the future. | 8 | 15% |
| II | **Thermal Engineering:** Historical development of steam engine, steam turbines, gas turbinesand hydraulic turbines; Principle of turbomachinery; History of IC engines; two stroke and four stroke engines-working, applications; Air compressors- types and uses; Principles of Rocket propulsion, chemical rockets, Indian space programme | 8 | 15% |
| | **FIRST INTERNAL EXAM** | | |
| III | **Refrigeration & Air Conditioning:** History & scope of refrigeration; applications of refrigeration; Food preservation, refrigerated storage; applications in chemical and process industries; special applications; Air conditioning- Principles & systems; scope of air conditioning; Psychrometric properties of air; Human comfort; comfort standards. | 7 | 15% |
| IV | **Automobile & Aeronautical Engineering**: Introduction to an Automobile; history of the automobile; Indian Automobiles; Types of automobiles; Major components and their functions; Manufacturers of motor vehicles in India; Fundamentals of aerodynamics; drag force and lift force; jet engines types and applications. | 7 | 15% |
| | **SECOND INTERNAL EXAM** | | |
| V | **Engineering Materials:** Introduction and history of materials; Basic crystallography; metals, alloys, composites, ceramics, polymers; mechanical properties and testing of engineering materials. | 5 | 20% |
| VI | **Manufacturing Engineering :** | 7 | 20% |

| | | | |
|---|---|---|---|
| | Methods of manufacturing; casting, forging, rolling, extrusion; machining operations – turning, milling, drilling, grinding, shaping, planing; Joining operations – soldering, brazing & welding; Introduction to CNC machines(elementary idea only); examples of typical products manufactured by above methods. | | |
| | **END SEMESTER EXAM** | | |



**Question Paper Pattern:**

**Part A:** Modules I and II – three questions of 15 marks each – out of which two questions are to be answered.

**Part B:** Modules III and IV – three questions of 15 marks each – out of which two questions are to be answered.

**Part C:** Modules V and VI – three questions of 20 marks each – out of which two questions are to be answered.

Each question can have maximum of four subdivisions (a,b,c,d).

| Course No: | Course Name | L-T-P Credits | Year of Introduction |
|---|---|---|---|
| BE110 | *ENGINEERING GRAPHICS | 1-1-3-3 | 2016 |

*As this course is practical oriented, the evaluation is different from other lecture based courses.

Points to note:

(1) End semester examination will be for 50 marks and of **3 hour** duration.

(2) End semester exam will include all modules except Module IV.

(3) 100 marks are allotted for internal evaluation: first internal exam 40 marks, second internal exam 40 marks(CAD Lab Practice) and class exercises 20 marks.

(4) The first internal exam will be based on modules I and II and the second internal exam will be a practical exam in CAD based on Module IV alone. Second internal exam may be conducted at the end of the semester.

**Course Objectives**

To enable the student to effectively communicate basic designs through graphical representations as per standards.

**Syllabus**

Introduction to Engineering Graphics; Orthographic projections of lines and solids, Isometric projection, Freehand sketching, Introduction to CAD, Sections of solids, Development of surfaces, Perspective projection.

**Expected outcome**

Upon successful completion of this course, the student would have accomplished the following abilities and skills:

1. Fundamental Engineering Drawing Standards.
2. Dimensioning and preparation of neat drawings and drawing sheets.
3. Interpretation of engineering drawings
4. The features of CAD software

**References Books**:


- Agrawal, B. and Agrawal, C. M., Engineering Drawing, Tata McGraw Hill Publishers
- Anilkumar, K. N., Engineering Graphics, Adhyuth Narayan Publishers
- Benjamin, J., Engineering Graphics, Pentex Publishers
- Bhatt, N., D., Engineering Drawing, Charotar Publishing House Pvt Ltd.
- Duff, J. M. and Ross, W. A., Engineering Design and Visualization, Cengage Learning, 2009
- John, K. C., Engineering Graphics, Prentice Hall India Publishers
- Kirstie Plantenberg, Engineering Graphics Essentials with AutoCAD 2016 Instruction, 4th Ed., SDC Publications
- Kulkarni, D. M., Rastogi, A. P. and Sarkar, A. K., Engineering Graphics with AutoCAD, PHI 2009
- Luzadder, W. J. and Duff, J. M., Fundamentals of Engineering Drawing, PHI 1993
- Parthasarathy, N. S., and Murali, V., Engineering Drawing, Oxford University Press
- Varghese, P. I., Engineering Graphics, V I P Publishers
- Venugopal, K., Engineering Drawing & Graphics, New Age International Publishers


**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | 6 exercises<br><br>Introduction to Engineering Graphics: Need for engineering drawing.<br><br>Drawing instruments; BIS code of practice for general engineering drawing.<br><br>Orthographic projections of points and lines:-Projections of points in different quadrants; Projections of straight lines inclined to one of the reference planes, straight lines inclined to both the planes; True length and inclination of lines with reference planes; Traces of lines. | 14 | 20% |

| | | | |
|---|---|---|---|
| II | 12 exercises<br><br>Orthographic projections of solids:-Projections of simple solids* in simple positions, projections of solids with axis inclined to one of the reference planes and axis inclined to both the reference planes. | 11 | 20% |
| | **FIRST INTERNAL EXAM** | | |
| III | 12 exercises<br><br>Isometric Projections:-Isometric projections and views of plane figures simple* and truncated simple* solids in simple position including sphere and hemisphere and their combinations.<br><br>Freehand sketching: Freehand sketching of real objects, conversion of pictorial views into orthographic views and vice versa. | 09 | 20% |
| IV | 6 exercises<br><br>Introduction to Computer Aided Drafting - familiarizing various coordinate systems and commands used in any standard drafting software - drawing of lines, circle, polygon, arc, ellipse, etc. Creating 2D drawings. Transformations: move, copy, rotate, scale, mirror, offset and array, trim, extend, fillet, chamfer. Dimensioning and text editing. Exercises on basic drafting principles, to create technical drawings. Creation of orthographic views of simple solids from pictorial views. Creation of isometric views of simple solids from orthographic views. Solid modelling and sectioning of solids, extraction of 2D drawings from solid models. (For internal examination only, not for University Examination). | 15<br><br>(Additional hours are allotted in U slot for CAD practice) | Internal |
| | **SECOND INTERNAL EXAM (to be conducted only after finishing CAD Practice.)** | | |
| V | 9 exercises<br><br>Sections and developments of solids: - Sections of simple* solids in simple vertical positions with section plane inclined to one of the reference planes - True shapes of sections. Developments of surfaces of these solids. | 12 | 20% |

| | | | |
|---|---|---|---|
| VI | 6 exercises<br><br>Intersection of surfaces: - Intersection of prism in prism and cylinder in cylinder - axis bisecting at right angles only. Perspective projections: - perspective projections of simple* solids. | 09 | 20% |
| *Triangular, square, pentagonal and hexagonal prisms, pyramids, cones and cylinders. | | | |
| **END SEMESTER EXAM** | | | |

Note:

1. First angle projection is to be followed.
2. CAD Practice is mandatory and shall be conducted in the time slot allotted for U slot in addition to 15 hours allotted for Module IV

**Question Paper Pattern:** Question Paper shall contain **eight** questions of 10 marks each out of which **five** questions are to be answered as explained below. **The duration of examination is 3 hours.**

Part A: **Three** questions from Modules I & II out of which **two** are to be answered.

Part B: **Five** questions from Modules III, V & VI out of which **three** are to be answered.

The questions are to be answered in A4 size booklet containing grid/plain sheets supplied by the university. Drawing sheets are not needed.

The evaluation of answers shall be based on the correctness of solution, judging the knowledge of student in concepts and principles of Engineering Graphics. Accuracy and neatness shall not be criteria for evaluation.

| Course No. | Course Name | L-T-P Credits | Year of Introduction |
|---|---|---|---|
| **EE100** | **BASICS OF ELECTRICAL ENGINEERING** | **2-1-0-3** | **2016** |

**Course Objectives**

To impart a basic knowledge in Electrical Engineering with an understanding of fundamental concepts.

**Syllabus**

Elementary concepts of electric circuits, Kirchhoff's laws, constant voltage and current sources, Matrix representation; Magnetic circuits, energy stored in magnetic circuits, Electromagnetic induction, Alternating current fundamentals; AC circuits, phasor representation of alternating quantities- rectangular, polar; Three phase systems, star and delta connection; Generation of power, power transmission and distribution; Transformers, Electric Machines-DC Machines, AC Motors.

**Expected outcome**

The course will enable the students to gain preliminary knowledge in basic concepts of Electrical Engineering.

**References Books**:


- Bhattacharya, S. K., Basic Electrical & Electronics Engineering, Pearson
- Bird, J., Electrical Circuit Theory and Technology, Routledge, Taylor & Francis Group
- Del Toro,V.,Electrical Engineering Fundamentals, Prentice Hall of India.
- Hayt, W. H., Kemmerly, J. E., and Durbin, S. M., Engineering Circuit Analysis, Tata McGraw Hill
- Hughes, Electrical and Electronic Technology, Pearson Education
- Mehta, V.K. and Mehta,R., Basic Electrical Engineering, S. Chand Publishing
- Parker and Smith, Problems in Electrical Engineering, CBS Publishers and Distributors
- Sudhakar and Syam Mohan, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill
- Suresh Kumar, K. S, Electric Circuits and Networks, Pearson Education


**Course Plan**

| Module | Contents | Hours | Sem. Exam. Marks |
|---|---|---|---|
| I | Elementary concepts of electric circuits: Kirchhoff's laws, constant voltage and current sources-Problems | **2** | **15%** |
| | Formation of network equations by mesh current and node voltage methods-matrix representation-solution of network equations by matrix methods-problems | **3** | |
| | star-delta conversion(resistive networks only-derivation is not needed)-problems | **1** | |

| | | | |
|---|---|---|---|
| II | Magnetic Circuits: MMF, field strength, flux density, reluctance(definition only)-comparison between electric and magnetic circuits | **2** | **15%** |
| | Energy stored in magnetic circuits, magnetic circuits with air gap-Numerical problems on series magnetic circuits | **2** | |
| | Electromagnetic Induction: Faraday's laws, lenz's laws- statically induced and dynamically induced emfs-self inductance and mutual inductance, coefficient of coupling (derivation not needed) | **2** | |
| **FIRST INTERNAL EXAMINATION** | | | |
| III | Alternating Current fundamentals: Generation of alternating voltages-waveforms, frequency, period, average , RMS values and form factor of periodic waveform(pure sinusoidal)-Numerical Problems | **2** | **15%** |
| | AC Circuits: Phasor representation of alternating quantities-rectangular and polar representation | **1** | |
| | Analysis of simple AC circuits: concept of impedance, power and power factor in ac circuits-active, reactive and apparent power | **2** | |
| | solution of RL,RC and RLC series circuits-Numerical problems | **2** | |
| | Three phase systems: Generation of three phase voltages-advantages of three phase systems, star and delta connection (balanced only), relation between line and phase voltages, line and phase currents | **3** | |
| | three phase power measurement by two wattmeter method (derivation is not required) - Numerical problems | **1** | |
| IV | Generation of power: Block schematic representation of generating stations- hydroelectric power plants | **1** | **15%** |
| | Block schematic representation of Thermal and nuclear power plants | **1** | |
| | Renewable energy sources: solar, wind, tidal and geothermal (Block diagram and working only- No Problems) | **1** | |
| | Power transmission: Typical electrical power transmission scheme-need for high voltage transmission-(Derivation is not needed, No Problems) | **1** | |
| | Power Distribution: substation equipments, primary and secondary transmission and distribution systems- feeder, service | **1** | |

| | | | |
|---|---|---|---|
| | mains | | |
| **SECOND INTERNAL EXAMINATION** | | | |
| V | Electric Machines: DC Generator and Motor-Construction-working principle- Back EMF | **2** | **20%** |
| | Types of motor-shunt, series, compound (short and long)-principle of operation of dc motor, applications-numerical problems ( voltage -current relations only) | **3** | |
| | Transformer: Construction of single phase and three phase Transformers (core type only)-EMF equation and related numerical problems | **2** | |
| | Losses and efficiency of transformer for full load –numerical problems (no equivalent circuit) | **2** | |
| VI | AC Motors: Three phase induction motor-squirrel cage and slip ring induction motor | **1** | **20%** |
| | Working principle-synchronous speed, slip and related numerical problems. (no equivalent circuit) | **1** | |
| | AC Motors: Construction, principles of operation of single phase induction motor (no equivalent circuit) | **1** | |
| | Starting methods in single phase induction motors -split phase and capacitor start | **2** | |
| **END SEMESTER EXAMINATION** | | | |

| Course Number | Course Name | L-T-P | Credits | Year of introduction |
|---|---|---|---|---|
| HS200 | Business Economics | 3-0-0 | 3 | 2016 |

## Course Objectives

- To familiarize the prospective engineers with elementary Principles of Economics and Managerial Economics;.
- To acquaint the students with tools and techniques that are useful in their profession in Managerial Decision Making which will enhance their employability;
- To gain understanding of some Macroeconomic concepts to improve their ability to understand the business climate;
- To prepare and understand balance sheet at an elementary level.

## Syllabus

Nature of economics. Demand and Supply Analysis, demand curve, supply curve and equilibrium price determination. Production economics, economies of Scale, optimal quantity determination, Production and Cost functions, the law of Diminishing Marginal Productivity, Costs, Break-Even Analysis Chart Preparation and Cost-Volume-Profit Analysis. Market Structure and Price-Output Decisions under various competition situations and Collusion/Cartel formations in the real life situation. Monetary theory, functions of RBI and NI. Computation and some aspects of macro economics. Capital Budgeting decisions, forecasting techniques and elementary Balance Sheet..



## Expected Outcome

*A student who has undergone this course*

- *would be able to make investment decisions based on capital budgeting methods in alignment with microeconomic and macroeconomic theories.*
- *would be able to analyse the profitability of the firm, economy of operation, determination of price under various market situations with good grasp on the effect of trade cycles in business.*
- *would gain knowledge on Monetary theory, measures by RBI in controlling interest rate and emerging concepts like Bit Coin.*
- *would gain knowledge of elementary accounting concepts used for preparing balance sheet and interpretation of balance sheet*

| Course Plan | | | |
|---|---|---|---|
| **Unit** | **Topics** | **Hours Allotted** | **Percentage Marks** |
| I | **Nature of Economics** Definitions of Economics and their limitations, Economic Problems (2 Hrs.), Economic Systems, meaning of Business or Managerial Economics (2 Hrs.)and its role and relevance in managerial decision making in an industrial setting (2 Hrs). | 6 | 15% |
| II | **Demand and Supply Analysis** Demand Curve, Demand function (2 Hrs.), Elasticity of demand and its estimation (2 Hrs.), Supply curve, equilibrium price and price mechanism (2 Hrs). | 6 | 15% |
| **FIRST INTERNAL EXAM** | | | |
| III | **Production Economics** Economies of Scale and Diseconomies of Scale (1 Hr.), Production and Cost Functions. Factors of Production (2 Hrs.), Law of Diminishing marginal Productivity. Construction and analysis of Break Even Charts (3 Hrs.) | 6 | 15% |
| IV | **Market Structure and Price-Output Decisions** Price and output determination under Perfect Competition, Monopoly and Monopolistic Competition (3 Hrs.). Collusion and Cartel, Nash Equilibrium (3 Hrs.). | 6 | 15% |
| **SECOND INTERNAL EXAM** | | | |
| V | **Money, National Income and Taxation** Money, Emerging Bit Coin concept, Quantity Theory of Money, Interest Rate Management (2 Hrs), Open Market Operations by RBI, Selective Credit Controls, SLR, CRR (2 Hrs), Definition & Measurement of National Income, methods, sectors of economy (3 Hrs), inflation, deflation, trade cycles- Value-Added Tax (2 Hrs). | 9 | 20% |
| VI | **Investment Decisions and Balance Sheet Analysis** Capital Budgeting, Investment Analysis – NPV, IRR, Profitability Index, ARR, Payback Period (3 Hrs), Depreciation, Time value of money. Business Forecasting– Elementary techniques (2 Hrs). Balance sheet preparation principles and interpretation (4 Hrs) | 9 | 20% |
| **END SEMESTER EXAM** | | | |



**Text Book**

Yogesh, Maheswari, *Management Economics* , PHI learning, NewDelhi, 2012

**References**


1. Dornbusch, Fischer and Startz, Macroeconomics, McGraw Hill, 11th edition, 2010.
2. Khan M Y, Indian Financial System, Tata McGraw Hill, 7th edition, 2011.
3. Samuelson, Managerial Economics, 6th edition, Wiley
4. Snyder C and Nicholson W, Fundamentals of Microeconomics, Cengage Learning (India), 2010.
5. Truett, Managerial Economics: Analysis, Problems, Cases, 8th Edition, Wiley Welch, Economics: Theory and Practice 7th Edition, Wiley

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| CY 110 | ENGINEERING CHEMISTRY LAB | 0-0-2-1 | 2016 |

**List of Exercises / Experiments (Minimum of 8 mandatory)**

1. Estimation of Total Hardness – EDTA method.
2. Estimation of Iron in Iron ore.
3. Estimation of Copper in Brass.
4. Estimation of dissolved oxygen by Winklers method.
5. Estimation of chloride in water.
6. Preparation of Urea formaldehyde and Phenol-formaldehyde resin.
7. Determination of Flash point and Fire point of oil by Pensky Martin Apparatus.
8. Determination of wavelength of absorption maximum and colorimetric estimation of $Fe^{3+}$ in solution.
9. Determination of molar absorptivity of a compound other than $Fe^{3+}$.
10. Analysis of IR spectra of any three organic compounds.
11. Analysis of $^{1}H$ NMR spectra of any three organic compounds.
12. Calibration of pH meter and determination of pH of a solution.
13. Verification of Nernst equation for electrochemical cell.
14. Potentiometric titrations: acid – base and redox titrations
15. Conductivity measurements of salt solutions.
16. Flame photometric estimation of Na+ to find out the salinity in sand.

**Expected outcome**

The student will be able to apply and demonstrate the theoretical concepts of Engineering Chemistry.

**References:**

- Practical Engineering Chemistry Lab Manual, Owl book publishers

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| CE110 | CIVIL ENGINEERING WORKSHOP | 0-0-2-1 | 2016 |

**List of Exercises / Experiments (Minimum of 8 mandatory)**

**(For Civil Engineering Branch)**

Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape only.

Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape and cross staff.

Construct a wall of height 50 cm and wall thickness 1½ bricks using English bond (No mortar required) - corner portion – length of side walls 60 cm.

Construct a wall of height 50 cm and wall thickness 2 bricks using English bond (No mortar required) - corner portion – length of side walls 60 cm.

Compute the area and/or volume of various features of a building/structure such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows etc. – To create an awareness of measurements and units (use tape or other simple measuring instruments like vernier caliper, screw gauge etc.).

Testing of building materials: The student should do the compression testing of any three construction materials and compare the strength (brick, hollow block, laterite block, cement concrete cube, stone block, and so on).

Computation of Centre of gravity and Moment of inertia of a given rolled steel section by actual measurements.

Introduction to simple plumbing and sanitary fittings.

Home assignment 1: Preparation of a building model - The students in batches should prepare and submit a building model for a given plinth area in a given site plan constrained by a boundary wall. The minimum requirements of a residential building viz., drawing cum dining room, one bed room and a kitchen should be included. The concept of an energy efficient building should also be included in the model.

Home assignment 2: Report preparation -The student should collect the construction details of any one unique Civil Engineering structure, prepare and submit a detailed report with neat illustrations.

Home assignment 3: Report preparation - The students should collect samples of building materials, prepare and submit a detailed report including their market rates.

**(For braches other than Civil Engineering)**

Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape only.

Setting out of a building: The student should set out a building (single room only) as per the

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|---|
| given building plan using tape and cross staff.<br><br>Building area computation: The student should prepare a rough sketch of a given single storeyed building and by taking linear measurements compute plinth area and carpet area of the given building.<br><br>Construct a wall of at least a height of 500mm and wall thickness 1brick using English bond (No mortar required) - corner portion – length of side walls at least 600mm.<br><br>Compute the area and/or volume of various features of a building/structure such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows etc. – To create an awareness of measurements and units (use tape or other simple measuring instruments like vernier calipers, screw gauge etc.).<br><br>Horizontal measurements: Find the area of an irregular polygon set out on the field.<br>Vertical measurements: Find the level difference between any two points.<br><br>Computation of Centre of gravity and Moment of inertia of a given rolled steel section by sketching and measurements.<br><br>Home assignment 1: Preparation of a building model - The students in batches should prepare and submit a building model for a given plinth area in a given site plan constrained by a boundary wall. The minimum requirements of a residential building viz., drawing cum dining room, one bed room and a kitchen should be included. The concept of an energy efficient building should also be included in the model.<br><br>Home assignment 2: Report preparation - The student should collect the construction details of an industrial building related to their branch of study, prepare and submit a detailed report with neat illustrations.<br><br>Home assignment 3: Report preparation - The students should collect samples of building materials, prepare and submit a detailed report about their market rates. |
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| |

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| CY100 | ENGINEERING CHEMISTRY | 3-1-0-4 | 2016 |

**Course Objectives**

To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like new generation engineering materials, storage devices, different instrumental methods etc. And to develop abilities and skills that are relevant to the study and practice of chemistry.

**Syllabus**

Spectroscopy - Principles and Applications, Electrochemistry - Electrodes, Electrochemical series and applications, Nernst Equation, Potentiometric titration and application, Cells, Instrumental Methods- Thermal Analysis, Chromatography; Conductivity, Chemistry of Engineering Materials, Copolymers, Conducting Polymers, Advanced Polymers, Nano materials, Fuels and Calorific value; Lubricants and their properties, Water Technology - Hardness, Water softening methods, Sewage water Treatment.

**Expected outcome**

The student will be able to apply the knowledge of chemistry and will be equipped to take up chemistry related topics as part of their project works during higher semester of the course.

**References Books**:


- Ahad, J., Engineering Chemistry, Jai Publications
- Dara, S. S., Engineering Chemistry, S Chand Publishers
- Fernandez, A., Engineering Chemistry, Owl Book Publishers, ISBN 9788192863382
- Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishers
- Kaurav, Engineering Chemistry with Laboratory Experiments. PHI, ISBN 9788120341746
- Manjooran K. S., Modern Engineering Chemistry, Kannatheri Publication
- Seymour, R. B., Introduction to Polymer Chemistry, McGraw Hill
- Rath, P., Engineering Chemistry, Cengage Learning, ISBN 9788131526699
- Wiley India, Engineering Chemistry, ISBN 9788126543205


**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Spectroscopy: Introduction, Beer Lamberts Law (no derivations)(Numericals) | 1 | 15% |
| | UV-visible spectroscopy - Principle, Instrumentation and applications | 2 | |
| | IR spectroscopy - Principle and applications (Numaericals) | 2 | |
| | $^1$H NMR spectroscopy - Principle, chemical shift - spin - spin splitting and applications including MRI(brief), Spectral Problems | 4 | |
| II | Electrochemistry: Different types of electrodes (general) – SHE, Calomel electrode, Glass electrode and determination of $E^0$ using SHE & Calomel | 2 | 15% |

| | | | |
|---|---|---|---|
| | electrode | | |
| | Electrochemical series and its applications.(Numericals) | 1 | |
| | Nernst equation - Derivation, application & numericals | 2 | |
| | Potentiometric titration - Acid-base and redox titration | 2 | |
| | Lithium ion cell and Fuel cell. | 1 | |
| **FIRST INTERNAL EXAM** | | | |
| **III** | Instrumental Methods: Thermal analysis - Principle, instrumentation and applications of TGA and DTA. | 3 | 15% |
| | Chromatographic methods - Basic principles, column, TLC. Instrumentation and principles of GC and HPLC. | 4 | |
| | Conductivity - Measurement of conductivity | 1 | |
| **IV** | Chemistry of Engineering Materials: Copolymers - BS, ABS - Structure and Properties. | 1 | 15% |
| | Conducting Polymers - Polyaniline, Polypyrrole - Preparation, Structure and Properties. | 2 | |
| | OLED – An introduction | 1 | |
| | Advanced Polymers – Kevlar, Polybutadiene rubber and silicone rubber: Preparation, Structure and Properties. | 2 | |
| | Nanomaterials – Definition, Classification, chemical methods of preparation - hydrolysis and reduction | 2 | |
| | Properties and Applications – Carbon Nano Tubes and fullerenes. | 1 | |
| **SECOND INTERNAL EXAM** | | | |
| **V** | Fuels and Lubricants: Fuels - Calorific Value, HCV and LCV - Determination of calorific value of a solid and liquid fuel by Bomb calorimeter - Dulongs formula and Numericals. | 3 | 20% |
| | Liquid fuel - Petrol and Diesel - Octane number & Cetane number | 1 | |
| | Biodiesel - Natural gas. | 2 | |
| | Lubricant - Introduction, solid, semisolid and liquid lubricants. | 1 | |
| | Properties of lubricants - Viscosity Index, Flash point, Fire point, Cloud point, Pour point and Aniline point. | 2 | |
| **VI** | Water Technology: Types of hardness, Units of hardness, Estimation of Hardness – EDTA method. Numericals based on the above | 3 | 20% |
| | Water softening methods - Ion exchange process - Principle. Polymer ion exchange. | 2 | |
| | Reverse Osmosis - Disinfection method by chlorination and UV | 1 | |
| | Dissolved oxygen, BOD and COD. | 2 | |
| | Sewage water Treatment - Trickling Filter and UASB process. | 1 | |
| **END SEMESTER EXAM** | | | |

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| EC110 | ELECTRONICS ENGINEERING WORKSHOP | 0-0-2-1 | 2016 |

**Course Objectives**

This course gives the basic introduction of electronic hardware systems and provides hands-on training with familiarization, identification, testing, assembling, dismantling, fabrication and repairing such systems by making use of the various tools and instruments available in the Electronics Workshop.

**List of Exercises / Experiments (Minimum of 8 mandatory)**

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)
2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools, Interpret data sheets of discrete components and IC's, Estimation and costing.
3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, CRO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de-soldering station etc.]
4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor, UJT and JFET using multimeter.]
5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]
6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]
7. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning(**Any Four circuits)**
   1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
   2. LED blinking circuit using a stable multi-vibrator with transistor BC 107.
   3. Square wave generation using IC 555 timer in IC base.
   4. Sine wave generation using IC 741 OP-AMP in IC base.
   5. RC coupled amplifier with transistor BC 107.
   6. AND and NAND gates in diode transistor logic.

8.Familiarization of electronic systems ( **Any three systems)**

1. Setting up of a PA system with different microphones, loud speakers, mixer etc.
2. Assembling and dismantling of desktop computer/laptop/mobile phones.
3. Coil/Transformer winding.
4. Identify the subsystems of TV, DTH, CCTV, Cable TV, CRO, Function generator etc.
5. Screen printing and PCB pattern transfer
6. Soldering & de-soldering of SMD using hot air soldering station.
7. Introduction to robotics- Familiarization of components (motor, sensors, battery etc.) used in robotics and assembling of simple robotic configurations.

**Expected outcome**

Student can identify the active and passive electronic components. Student gets hands-on assembling, testing, assembling, dismantling, fabrication and repairing systems by making use of the various tools and instruments available in the Electronics Workshop.

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| BE100 | ENGINEERING MECHANICS | 3-1-0-4 | 2016 |

**Course Objectives**

1. To apply the principles of mechanics to practical engineering problems.
2. To identify appropriate structural system for studying a given problem and isolate it from its environment.
3. To develop simple mathematical model for engineering problems and carry out static analysis.
4. To carry out kinematic and kinetic analyses for particles and systems of particles.

**Syllabus**

Statics: Fundamental concepts and laws of mechanics; Force systems; Principle of moments; Resultant of force and couple systems; Equilibrium of rigid body; Free body diagram; Equilibrium of a rigid body in three dimension; Support reactions; Properties of surfaces and solids - Centroid, Moment of inertia, Polar moment of inertia, Mass moment of inertia, Product of inertia and Principal moment of inertia; Theorems of Pappus – Guldinus; Friction; Principle of virtual work.

Dynamics: Rectangular and cylindrical coordinate system; Combined motion of rotation and translation; Newton's second law in rectilinear translation; D' Alembert's principle; Mechanical vibration; Simple harmonic motion; Spring-mass model.

**Expected outcome**

1. Students will be able to apply and demonstrate the concepts of mechanics to practical engineering problems.
2. Students will be able to determine the properties of planes and solids.
3. Students will be able to apply fundamental concepts of dynamics to practical problems.

**Text Books**:

- Shames, I. H., Engineering Mechanics - Statics and Dynamics, Pearson Prentice
- Timoshenko, S. & Young D. H., Engineering Mechanics, McGraw Hill

**References Books**:

- Babu, J., Engineering Mechanics, Pearson Prentice Hall
- Beer and Johnson, Vector Mechanics for Engineers - Statics and Dynamics, Tata McGraw Hill Publishing Company Limited
- Benjamin J., Engineering Mechanics, Pentex Book Publishers and Distributors
- Bhavikkatti, S. S., Engineering Mechanics, New Age International Publishers
- Hibbeler, R. C., Engineering Mechanics: Statics and Dynamics. Pearson Prentice Hall
- Kumar, K. L., Engineering Mechanics, Tata McGraw Hill Publishing Company Limited
- Merriam J. L. and Kraige L. G., Engineering Mechanics – Vol. I and II, John Wiley
- Rajasekaran S. and Sankarasubramanian, G., Engineering Mechanics, Vikas Publishing House Private Limited
- Tayal, A. K., Engineering Mechanics- Statics and Dynamics, Umesh Publications

| Course Plan | | | |
|---|---|---|---|
| **Module** | **Contents** | **Hours** | **Sem. Exam Marks** |
| I | Statics: Fundamental concepts and laws of mechanics – Rigid body – Principle of transmissibility of forces | 2 | 15% |
| | Coplanar force systems - Moment of a force – Principle of moments | 2 | |
| | Resultant of force and couple system | 4 | |
| | Equilibrium of rigid body – Free body diagram – Conditions of equilibrium in two dimensions – Two force and three force members. | 3 | |
| II | Types of supports – Problems involving point loads and uniformly distributed loads only. | 5 | 15% |
| | Force systems in space – Degrees of freedom – Free body diagram – Equations of equilibrium – Simple resultant and Equilibrium problems. | 4 | |
| **FIRST INTERNAL EXAM** | | | |
| III | Properties of planar surfaces – Centroid and second moment of area (Derivations not required) - Parallel and perpendicular axis theorem – Centroid and Moment of Inertia of composite area. | 3 | 15% |
| | Polar Moment of Inertia – Radius of gyration – Mass moment of inertia of cylinder and thin disc (No derivations required). | 2 | |
| | Product of inertia – Principal Moment of Inertia (conceptual level). | 3 | |
| | Theorems of Pappus and Guldinus. | 1 | |
| IV | Friction – Characteristics of dry friction – Problems involving friction of ladder, wedges and connected bodies. | 6 | 15% |
| | Definition of work and virtual work – Principle of virtual work for a system of connection bodies – Problems on determinate beams only. | 4 | |
| **SECOND INTERNAL EXAM** | | | |
| V | Dynamics: Rectangular and Cylindrical co-ordinate system | 1 | 20% |
| | Combined motion of rotation and translation – Concept of instantaneous centre – Motion of connecting rod of piston and crank of a reciprocating pump. | 4 | |
| | Rectilinear translation – Newton's second law – D'Alembert's Principle – Application to connected bodies (Problems on motion of lift only). | 4 | |
| VI | Mechanical vibrations – Free and forced vibration - Degree of freedom. | 1 | 20% |
| | Simple harmonic motion – Spring-mass model – Period – Stiffness – Frequency – Simple numerical problems of single degree of freedom. | 7 | |
| **END SEMESTER EXAM** | | | |

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| HS210 | LIFE SKILLS | 2-0-2 | 2016 |

**Course Objectives**

- To develop communication competence in prospective engineers.
- To enable them to convey thoughts and ideas with clarity and focus.
- To develop report writing skills.
- To equip them to face interview & Group Discussion.
- To inculcate critical thinking process.
- To prepare them on problem solving skills.
- To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
- To understand team dynamics & effectiveness.
- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
- To learn leadership qualities and practice them.

**Syllabus**

**Communication Skill:** Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

**Critical Thinking & Problem Solving:** Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping & Analytical Thinking.

**Teamwork:** Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

**Ethics, Moral & Professional Values:** Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

**Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation.

**Expected outcome**

- Communicate effectively.
- Make effective presentations.
- Write different types of reports.
- Face interview & group discussion.
- Critically think on a particular problem.
- Solve problems.
- Work in Group & Teams
- Handle Engineering Ethics and Human Values.
- Become an effective leader.

**References:**


- Barun K. Mitra; (2011), *"Personality Development & Soft Skills"*, First Edition; Oxford Publishers.
- Kalyana; (2015) "*Soft Skill for Managers*"; First Edition; Wiley Publishing Ltd.
- Larry James (2016); "*The First Book of Life Skills*"; First Edition; Embassy Books.
- Shalini Verma (2014); *"Development of Life Skills and Professional Practice"*; First Edition; Sultan Chand (G/L) & Company
- John C. Maxwell (2014); "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc.


**Course Plan**

| Module | Contents | Hours L-T-P T | P | Sem. Exam Marks |
|---|---|---|---|---|
| I | Need for Effective Communication, Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication, Types of barriers; Miscommunication; Noise; Overcoming measures, | 2 | | |
| | Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills. | | 2 | |
| | **Technical Writing:** Differences between technical and literary style, Elements of style; Common Errors, **Letter Writing:** Formal, informal and demi-official letters; business letters, **Job Application**: Cover letter, Differences between bio-data, CV and Resume, **Report Writing:** Basics of Report Writing; Structure of a report; Types of reports. | | 4 | |
| | **Non-verbal Communication and Body Language:** Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language | 3 | | |
| | **Interview Skills**: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication, **Group Discussion**: Differences between group discussion and debate; Ensuring success in group discussions, **Presentation Skills**: Oral presentation and public speaking skills; business presentations, **Technology-based Communication:** Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software. | | 4 | |
| II | Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity | 2 | | |

| | | | | |
|---|---|---|---|---|
| | Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.<br><br>Steps in problem solving, Problem Solving Techniques, Problem Solving through Six Thinking Hats, Mind Mapping, Forced Connections.<br><br>Problem Solving strategies, Analytical Thinking and quantitative reasoning expressed in written form, Numeric, symbolic, and graphic reasoning, Solving application problems. | 2 | 2<br><br>2 | |
| **III** | Introduction to Groups and Teams, Team Composition, Managing Team Performance, Importance of Group, Stages of Group, Group Cycle, Group thinking, getting acquainted, Clarifying expectations.<br><br>Group Problem Solving, Achieving Group Consensus.<br><br>Group Dynamics techniques, Group vs Team, Team Dynamics, Teams for enhancing productivity, Building & Managing Successful Virtual Teams. Managing Team Performance & Managing Conflict in Teams.<br><br>Working Together in Teams, Team Decision-Making, Team Culture & Power, Team Leader Development. | 3<br><br>3 | 2<br><br>2 | |
| **IV** | Morals, Values and Ethics, Integrity, Work Ethic, Service Learning, Civic Virtue, Respect for Others, Living Peacefully.<br><br>Caring, Sharing, Honesty, Courage, Valuing Time, Cooperation, Commitment, Empathy, Self-Confidence, Character,<br><br>Spirituality, Senses of 'Engineering Ethics', variety of moral issued, Types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Consensus and controversy, Models of Professional Roles, Theories about right action, Self-interest, customs and religion, application of ethical theories.<br><br>Engineering as experimentation, engineers as responsible experimenters, Codes of ethics, Balanced outlook on.<br><br>The challenger case study, Multinational corporations, Environmental ethics, computer ethics,<br><br>Weapons development, engineers as managers, consulting | 3<br><br>3<br><br>3 | 2<br><br>2 | |

| | | | | |
|---|---|---|---|---|
| | engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE), India, etc. | 3 | | |
| **V** | Introduction, a framework for considering leadership, entrepreneurial and moral leadership, vision, people selection and development, cultural dimensions of leadership, style, followers, crises.<br><br>Growing as a leader, turnaround leadership, gaining control, trust, managing diverse stakeholders, crisis management<br><br>Implications of national culture and multicultural leadership Types of Leadership, Leadership Traits.<br><br>Leadership Styles, VUCA Leadership, DART Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders, making of a Leader, Formulate Leadership | 4<br><br>2<br><br>2 | <br><br>2<br><br><br><br>2 | |
| **END SEMESTER EXAM** | | | | |

## EVALUATION SCHEME

**Internal Evaluation**

*(Conducted by the College)*



**Total Marks: 100**

### Part – A

***(To be started after completion of Module 1 and to be completed by 30th working day of the semester)***

1. Group Discussion – Create groups of about 10 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation is as follows;

| | | | |
|---|---|---|---|
| (i) | Communication Skills | – | 10 marks |
| (ii) | Subject Clarity | – | 10 marks |
| (iii) | Group Dynamics | - | 10 marks |
| (iv) | Behaviors & Mannerisms | - | 10 marks |

*(Marks: 40)*

### Part – B

***(To be started from 31st working day and to be completed before 60th working day of the semester)***

2. Presentation Skills – Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation is as follows;

| | | | |
|---|---|---|---|
| (i) | Communication Skills* | - | 10 marks |
| (ii) | Platform Skills** | - | 10 marks |
| (iii) | Subject Clarity/Knowledge | - | 10 marks |

*(Marks: 30)*

* Language fluency, auditability, voice modulation, rate of speech, listening, summarizes key learnings etc.

** Postures/Gestures, Smiles/Expressions, Movements, usage of floor area etc.

**Part – C**

***(To be conducted before the termination of semester)***

3. Sample Letter writing or report writing following the guidelines and procedures. Parameters to be used for evaluation is as follows;

| | | | |
|---|---|---|---|
| (i) | Usage of English & Grammar | - | 10 marks |
| (ii) | Following the format | - | 10 marks |
| (iii) | Content clarity | - | 10 marks |

*(Marks: 30)*



**External Evaluation**

*(Conducted by the University)*

Total Marks: 50 Time: 2 hrs.

**Part – A**

**Short Answer questions**

There will be one question from each area (five questions in total) will be asked for the examination. Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows;

| | |
|---|---|
| (i) | Content Clarity/Subject Knowledge |
| (ii) | Presentation style |
| (iii) | Organization of content |

*(Marks: 5 x 6 = 30)*

## Part – B

### Case Study

The students will be given a case study with questions at the end the students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows;

(i) Analyze the case situation
(ii) Key players/characters of the case
(iii) Identification of the problem (both major & minor if exists)
(iv) Bring out alternatives
(v) Analyze each alternative against the problem
(vi) Choose the best alternative
(vii) Implement as solution
(viii) Conclusion
(ix) Answer the question at the end of the case

*(Marks: 1 x 20 = 20)*

| COURSE NO. | COURSE NAME | CREDITS | YEAR OF INTRODUCTION |
|---|---|---|---|
| **MA 101** | **CALCULUS** | **4** | **2016** |

**Course Objectives**

In this course the students are introduced to some basic tools in Mathematics which are useful in modelling and analysing physical phenomena involving continuous changes of variables or parameters. The differential and integral calculus of functions of one or more variables and of vector functions taught in this course have applications across all branches of engineering. This course will also provide basic training in plotting and visualising graphs of functions and intuitively understanding their properties using appropriate software packages.

**Syllabus**

Single Variable Calculus and Infinite series, Functions of more than one variable, Partial derivatives and its applications, Calculus of vector valued functions, Multiple Integrals.

**Expected outcome**

At the end of the course the student will be able to (i) check convergence of infinite series (ii) find maxima and minima of functions two variables (iii) find area and volume using multiple integrals (iv) apply calculus of vector valued functions in physical applications and (v) visualize graphs and surfaces using software or otherwise.

**Text Books**

(1)Anton, Bivens, Davis: Calculus, John Wiley and Sons, 10th ed

(2)Thomas Jr., G. B., Weir, M. D. and Hass, J. R., Thomas' Calculus, Pearson

**References:**


1. Sengar and Singh, Advanced Calculus, Cengage Learning, Ist Edition
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India edition, 10th ed.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi.
4. N. P. Bali, Manish Goyal, Engineering Mathematics, Lakshmy Publications
5. D. W. Jordan, P Smith. Mathematical Techniques, Oxford University Press, 4th

| |
|---|
| Edition.<br>6. A C Srivastava, P K Srivasthava, Engineering Mathematics Vol 1. PHI Learning Private Limited, New Delhi. |

| | | | |
|---|---|---|---|
| | COURSE NO: MA101 | L-T-P:3-1-0 | |
| | COURSE NAME: CALCULUS | CREDITS:4 | |
| MODULE | CONTENT | HRS | END SEM. MARK % |
| I | **Single Variable Calculus and Infinite series**<br>**(Book I –sec 9.3,9.5,9.6,9.8)**<br>Basic ideas of infinite series and convergence - .Geometric series- Harmonic series-Convergence tests-comparison, ratio, root tests (without proof). Alternating series- Leibnitz Test- Absolute convergence, Maclaurins series-Taylor series - radius of convergence.<br>(For practice and submission as assignment only:<br>Sketching, plotting and interpretation of hyperbolic functions using suitable software. Demonstration of convergence of series bysoftware packages) | 9 | 15% |
| II | **Partial derivatives and its applications(Book I –sec. 13.3 to 13.5 and 13.8)**<br>Partial derivatives–Partial derivatives of functions of more than two variables - higher order partial derivatives - differentiability, differentials and local linearity -<br>The chain rule – Maxima and Minima of functions of two variables - extreme value theorem (without proof)-relative extrema . | 5<br>4 | 15% |

| | | | |
|---|---|---|---|
| **FIRST INTERNAL EXAM** | | | |
| III | **Calculus of vector valued functions(Book I-12.1,12.2,12.4&12.6,13.6 &13.7)**<br>Introduction to vector valued functions- parametric curves in 3-space<br>Limits and continuity – derivatives - tangent lines – derivative of dot and cross product- definite integrals of vector valued functions-<br>unit tangent-normal- velocity-acceleration and speed–Normal and tangential components of acceleration.<br>Directional derivatives and gradients-tangent planes and normal vectors<br>(For practice and submission as assignment only: Graphing parametric curves and surfaces using software packages ) | 3<br>3<br>3 | 15% |
| IV | **Multiple integrals**<br>**(Book I-sec. 14.1, 14.2, 14.3, 14.5)**<br>Double integrals- Evaluation of double integrals – Double integrals in non-rectangular coordinates- reversing the order of integration-<br>Area calculated as a double integral-<br>Triple integrals(Cartesian co ordinates only)-<br>volume calculated as a triple integral-<br>(applications of results only) | 4<br>2<br>2<br>2 | 15% |
| **SECOND INTERNAL EXAM** | | | |
| | **Topics in vector calculus**<br>**(Book I-15.1, 15.2, 15.3)**<br>Vector and scalar fields- Gradient fields – | 2 | |

| | | | |
|---|---|---|---|
| V | conservative fields and potential functions –<br>divergence and curl - the $\nabla$ operator - the Laplacian $\nabla^2$ ,<br>Line integrals - work as a line integral-<br>independence of path-conservative vector field –<br>(For practice and submission as assignment only: graphical representation of vector fields using software packages) | 2<br>2<br>2<br>2 | 20% |
| VI | **Topics in vector calculus (continued)**<br>**(Book I sec., 15.4, 15.5, 15.7, 15.8)**<br>Green's Theorem (without proof- only for simply connected region in plane),<br>surface integrals –<br>Divergence Theorem (without proof for evaluating surface integrals) ,<br>Stokes' Theorem (without proof for evaluating line integrals)<br>(All the above theorems are to be taught in regions in the rectangular co ordinate system only) | 2<br>2<br>3<br>3 | 20% |
| **END SEMESTER EXAM** | | | |

Open source software packages such as gnuplot, maxima, scilab ,geogebra or R may be used as appropriate for practice and assignment problems.

TUTORIALS: Tutorials can be ideally conducted by dividing each class in to three groups. Prepare necessary materials from each module that are to be taught using computer. Use it uniformly to every class.

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| MA102 | DIFFERENTIAL EQUATIONS | 3-1-0-4 | 2016 |

**Course Objectives**

This course introduces basic ideas of differential equations, both ordinary and partial, which are widely used in the modelling and analysis of a wide range of physical phenomena and has got applications across all branches of engineering. The course also introduces Fourier series which is used by engineers to represent and analyse periodic functions in terms of their frequency components.

**Syllabus**

Homogeneous linear ordinary differential equation, non-homogeneous linear ordinary differential equations, Fourier series, partial differential equation, one dimensional wave equation, one dimensional heat equation.

**Expected Outcome**

At the end of the course students will have acquired basic knowledge of differential equations and methods of solving them and their use in analysing typical mechanical or electrical systems. The included set of assignments will familiarise the students with the use of software packages for analysing systems modelled by differential equations.

**TEXT BOOKS**


- Erwin Kreyszig: Advanced Engineering Mathematics, 10th ed. Wiley
- A C Srivastava, P K Srivasthava, Engineering Mathematics Vol 2. PHI Learning Private Limited, New Delhi.


**REFERENCES:**


- Simmons: Differential Equation with Applications and its historical Notes,2e McGrawHill Education India 2002
- Datta, Mathematical Methods for Science and Engineering. CengageLearing,1st. ed
- B. S. Grewal. Higher Engineering Mathematics, Khanna Publishers, New Delhi.
- N. P. Bali, Manish Goyal. Engineering Mathematics, Lakshmy Publications
- D. W. Jordan, P Smith. Mathematical Techniques, Oxford University Press, 4th Edition.
- C. Henry Edwards, David. E. Penney. Differential Equations and Boundary Value Problems. Computing and Modelling, 3rd ed. Pearson

| COURSE PLAN | | | |
|---|---|---|---|
| | **COURSE NO: MA102** | **L-T-P:3-1-0** | |
| | **COURSE NAME: DIFFERENTIAL EQUATIONS** | **CREDITS:4** | |
| **MODULE** | **CONTENT** | **HRS** | **END SEM. EXAM MARKS (OUT OF 100)** |
| **I** | HOMOGENEOUS DIFFERENTIAL EQUATIONS<br>(Text Book 1 : Sections 1.7, 2.1, 2.2, 2.6, 3.2)<br>Existence and uniqueness of solutions for initial value problems, Homogenous linear ODEs of second order. Homogenous linear ODEs with constant coefficients, Existence and Uniqueness of solutions Wronskian,<br>Homogenous linear ODEs with constant Coefficients (Higher Order)<br>(For practice and submission as assignment only: Modelling of free oscillations of a mass – spring system) | **3**<br>**4** | **17** |
| **II** | NON-HOMOGENEOUS LINEAR ORDINARY DIFFERENTIAL EQUATIONS<br>( Text Book 2: Sections 1.2.7 to 1.2.14)<br>The particular Integral (P.I.), Working rule for P.I. when g(x) is $X^m$ , To find P.I. when g(x) = $e^{ax}.V_1(x)$, Working rule for P.I. when g(x) = x.V(x), Homogeneous Linear Equations, PI of Homogenous equations<br>Legendre's Linear equations<br>Method of variation of parameters for finding PIs<br>(For practice and submission as assignments only: Modelling forced oscillations, resonance, electric circuits ) | **7**<br>**2**<br>**3** | **17** |
| **FIRST INTERNAL EXAM** | | | |
| **III** | FOURIER SERIES<br>(Text Book 2 - Sections 4.1,4.2,4.3,4.4)<br>Periodic functions ,Orthogonally of Sine and Cosine functions (Statement only), Fourier series and Euler's formulas<br>Fourier cosine series and Fourier sine series<br>(Fourier series of even and Odd functions )<br>Half range expansions (All results without proof) | **3**<br>**3**<br>**3** | **17** |

| | | | |
|---|---|---|---|
| | (For practice and submission as assignment only:<br>Plots of partial sums of Fourier series and demonstrations of convergence using plotting software) | | |
| **IV** | PARTIAL DIFFERENTIAL EQUATIONS<br>( Text Book 2 : Sections : 5.1, 5.1.1, 5.1.2, 5.1.5, 5.2.6- 5.2.10)<br>Introduction to partial differential equations , formation of PDE, Solutions of first order PDE(Linear only)<br>Lagrange's Method<br>Linear PDE with constant coefficients , Solutions of Linear Homogenous PDE with constant coefficients , Shorter method for finding PI when g(x,y)=f(ax+by), Method of finding PI when g(x,y) = $x^m y^n$, method of find PI when<br>g(x,y)= e $^{ax+by}$ V(x,y) | **3**<br>**3**<br>**6** | **17** |
| **SECOND INTERNAL EXAM** | | | |
| **V** | ONE DIMENSIONAL WAVE EQUATION<br>( Text Book 2: Sections :6.1-- 6.4)<br>Method of separation of variables<br>The wave Equation<br>Vibrations of a stretched string<br>Solutions of one dimensional wave equation using method of separation of variables and problems | **2**<br>**1**<br>**1**<br>**4** | **16** |
| **VI** | ONE DIMENSIONAL HEAT EQUATION<br>( Text Book 2: sections 6.7, 6.8 ,6.9, 6.9.1 ,6.9.2)<br>The equation of Heat conduction<br>One dimensional Heat transfer equation.<br>Solutions of One Dimensional Heat transfer equation, A long insulated rod with ends at zero temperatures, A long insulated rod with ends at non zero temperatures | **1**<br>**1**<br>**6** | **16** |
| **END SEMESTER EXAM** | | | |

TUTORIALS: Tutorials can be ideally conducted by dividing each class into three groups. Prepare necessary materials from each module that can be practiced using computer software. Use them uniformly in every class.

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| ME110 | MECHANICAL ENGINEERING WORKSHOP | 0-0-2-1 | 2016 |

**Course Objectives**

Introduction to manufacturing processes and applications. Familiarization of various tools, measuring devices, practices and machines used in various workshop sections.

**List of Exercises / Experiments (Minimum of 8 mandatory)**

| Sl. No. | Name of Shop floor | Exercises | No of sessions |
|---|---|---|---|
| 1 | General | Studies of mechanical tools, components and their applications:<br>(a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc. And accessories<br>(b) Components: Bearings, seals, O-rings, circlips, keys etc. | 1 |
| 2 | Carpentry | Any one model from the following:<br>1. T-Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joint | 2 |
| 3 | Smithy | (a) Demonstrating the forgability of different materials (MS, Al, Alloy steel and Cast steel) in cold and hot states.<br>(b) Observing the qualitative differences in the hardness of these materials<br>(c) Determining the shape and dimensional variations of Al test specimen due to forging under different states by visual inspection and measurements | 2 |
| 4 | Foundry | Any one exercise from the following<br>1. Bench moulding 2. Floor moulding 3. Core making | 2 |
| 5 | Sheet metal | Any one exercise from the following<br>Making 1. Cylindrical 2. Conical 3. Prismatic shaped jobs from sheet metal | 2 |
| 6 | Welding | Any one exercise from the following<br>Making joints using Electric arc welding. Bead formation in horizontal, vertical and overhead positions | 2 |
| 7 | Fitting and Assembly | Filing exercise and any one of the following exercises<br>Disassembling and reassembling of 1. Cylinder piston assembly 2. Tail stock assembly 3. Time piece/clock 4. Bicycle or any machine. | 2 |
| 8 | Machines | Demonstration and applications of Drilling machine, Grinding machine, Shaping machine, Milling machine and lathe | 2 |

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| PH110 | ENGINEERING PHYSICS LAB | 0-0-2-1 | 2016 |

**Course Objectives**

This course is designed (i) to impart practical knowledge about some of the phenomena they have studied in the Engineering Physics course and (ii) to develop the experimental skills of the students.

**List of Exercises / Experiments (Minimum of 8 mandatory)**

**Basics**

1. Study of application of Cathode Ray Oscilloscope (CRO) for Frequency and Amplitude measurements. Lissajeous figures (useful for different types of polarized light.)
2. Temperature measurement – Thermocouple
3. Measurement of strain using strain gauge and Wheatstones bridge.

**Waves, Oscillations and Ultrasonics**

4. Wave length and velocity measurement of ultrasonic waves in a liquid using ultrasonic diffractometer.
5. The LCR Circuit – Forced and damped harmonic oscillations.
6. Meldes string apparatus. Measurement of frequency in the transverse and longitudinal mode.

**Interference**

7. Wave length measurement of a monochromatic source of light using Newton's Rings method.
8. Determination of refractive index of a liquid using Newton's Rings apparatus.
9. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.

**Diffraction**

10. To determine the slit or pinhole width.
11. To measure wavelength using a millimeter scale as a grating.
12. Determination the wavelength of He-Ne laser or any standard laser using diffraction grating.
13. To determine the wavelength of monochromatic light using grating.
14. Determination of dispersive power and resolving power of a plane transmission grating.

**Polarisation**

15. Kerr Effect - To demonstrate the Kerr effect in nitrobenzene solution and to measure the light intensity as a function of voltage across the Kerr cell using photo detector.
16. To measure the light intensity of plane polarised light as a function of the analyzer position.
17. Laurent's Half Shade Polarimeter -To observe the rotation of the plane of polarization of monochromatic light by sugar solution and hence to determine the concentration of solution of optically active substance.

**Laser & Photonics**

18. To determine the speed of light in air using laser.
19. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
20. Determination of the particle size of lycopodium powder.
21. I-V characteristics of solar cell
22. To measure Planck's constant using photo electric cell.
23. Measurement of wavelength of laser using grating.

**Reference Books**:


- Avadhanulu, M. N., Dani, A. A. and Pokley, P. M., Experiments in Engineering Physics, S. Chand & Co.
- Gupta, S. K., Engineering Physics Practicals, Krishna Prakashan Pvt. Ltd.
- Koser, A. A., Practical Engineering Physics, Nakoda Publishers and Printers India Ltd
- Rao, B. S. and Krishna, K. V., Engineering Physics Practicals, Laxmi Publications
- Sasikumar, P. R. Practical Physics, PHI.


**Website:**

- http://www.indosawedu.com

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| PH100 | ENGINEERING PHYSICS | 3-1-0-4 | 2016 |

**Course Objectives**

Most of the engineering disciplines are rooted in Physics. In fact a good engineer is more or less an applied physicist. This course is designed to provide a bridge to the world of technology from the basics of science and to equip the students with skills in scientific inquiry, problem solving, and laboratory techniques.

**Syllabus**

Harmonic Oscillations: Damped and Forced Harmonic Oscillations. Waves: One Dimensional and Three Dimensional waves, Interference: Interference in thin films (Reflected system) Diffraction: Fraunhofer and Fresnel Diffraction, Grating, Polarization of Light: Double refraction, production and detection of polarized light, Superconductivity: Properties and Applications. Quantum Mechanics: Schrodinger Equations- Formulation and Solution, Operators, Applications. Statistical Mechanics: Microstates and macro states Maxwell - Boltzmann, Bose-Einstein and Fermi Dirac statistics. Fermi level and its significance. Acoustics: Intensity of sound, Reverberation and design concepts, Ultrasonics: Production, Detection and Applications, NDT methods, Lasers: Properties, Working Principles, Practical Lasers. Photonics: Basics of Solid State lighting, Photo detectors, Solar Cells, Fiber Optics.

**Expected outcome**

Familiarity with the principles of Physics and its significance in engineering systems and technological advances.

**References:**


- Aruldhas, G., Engineering Physics, PHI Ltd.
- Beiser, A., Concepts of Modern Physics, McGraw Hill India Ltd.
- Bhattacharya and Tandon, Engineering Physics , Oxford India
- Brijlal and Subramanyam, A Text Book of Optics, S. Chand & Co.
- Dominic and Nahari, A Text Book of Engineering Physics, Owl Books Publishers
- Hecht, E., Optics, Pearson Education
- Mehta, N., Applied Physics for Engineers, PHI Ltd
- Palais, J. C., Fiber Optic Communications, Pearson Education
- Pandey, B. K. and Chathurvedi, S., Engineering Physics, Cengage Learning
- Philip, J., A Text Book of Engineering Physics, Educational Publishers
- Premlet, B., Engineering Physics, Mc GrawHill India Ltd
- Sarin, A. and Rewal, A., Engineering Physics, Wiley India Pvt Ltd
- Sears and Zemansky, University Physics , Pearson
- Vasudeva, A. S., A Text Book of Engineering Physics, S. Chand & Co

**Web:**

www.physics.org

www.howstuffworks.com

www.physics.about.com

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Harmonic Oscillations: Differential equation of damped harmonic oscillation, forced harmonic oscillation and their solutions- Resonance, Q factor, Sharpness of resonance- LCR circuit as an electrical analogue of Mechanical Oscillator (Qualitative) | 5 | 15% |
| | Waves: One dimensional wave - differential equation and solution. Three dimensional waves - Differential equation & its solution. (No derivation) Transverse vibrations of a stretched string. | 4 | |
| II | Interference: Coherence. Interference in thin films and wedge shaped films (Reflected system) Newton's rings-measurement of wavelength and refractive index of liquid Interference filters. Antireflection coating. | 5 | 15% |
| | Diffraction Fresnel and Fraunhofer diffraction. Fraunhofer diffraction at a single slit. Plane transmission grating. Grating equation - measurment of wavelength. Rayleigh's criterion for resolution of grating- Resolving power and dispersive power of grating. | 4 | |
| | **FIRST INTERNAL EXAM** | | |
| III | Polarization of Light: Types of polarized light. Double refraction. Nicol Prism. Quarter wave plate and half wave plate. Production and detection of circularly and elliptically polarized light. Induced birefringence- Kerr Cell - Polaroid & applications. | 4 | 15% |
| | Superconductivity: Superconducting phenomena. Meissner effect. Type-I and Type-II superconductors. BCS theory (qualitative). High temperature superconductors - Applications of superconductors. | 5 | |
| IV | Quantum Mechanics: Uncertainty principle and its applications- formulation of Time dependent and Time independent Schrödinger equations- physical meaning of wave function- Energy and momentum Operators-Eigen values and functions- One dimensional infinite square well potential .Quantum mechanical Tunnelling (Qualitative) | 6 | 15% |
| | Statistical Mechanics: Macrostates and Microstates. Phase space. Basic postulates of Maxwell- Boltzmann, Bose-Einstein and Fermi Dirac | 3 | |

| | | | |
|---|---|---|---|
| | statistics. Distribution equations in the three cases (no derivation). Fermi Level and its significance. | | |
| | **SECOND INTERNAL EXAM** | | |
| V | Acoustics: Intensity of sound- Loudness-Absorption coefficient - Reverberation and reverberation time- Significance of reverberation time- Sabine's formula (No derivation) -Factors affecting acoustics of a building. | 3 | 20% |
| | Ultrasonics: Production of ultrasonic waves - Magnetostriction effect and Piezoelectric effect - Magnetostriction oscillator and Piezoelectric oscillator - Detection of ultrasonics - Thermal and piezoelectric methods- Applications of ultrasonics - NDT and medical. | 4 | |
| **VI** | Laser: Properties of Lasers, absorption, spontaneous and stimulated emissions, Population inversion, Einstein's coefficients, Working principle of laser,Optial resonant cavity. Ruby Laser, Helium-Neon Laser, Semiconductor Laser (qualitative). Applications of laser, holography (Recording and reconstruction) | 5 | 20% |
| | Photonics: Basics of solid state lighting - LED – Photodetectors - photo voltaic cell, junction & avalanche photo diodes, photo transistors, thermal detectors, Solar cells- I-V characteristics - Optic fibre-Principle of propagation-numerical aperture-optic communication system (block diagram) - Industrial, medical and technological applications of optical fibre. Fibre optic sensors - Basics of Intensity modulated and phase modulated sensors. | 5 | |
| | **END SEMESTER EXAM** | | |

| Course No. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| MA201 | LINEAR ALGEBRA AND COMPLEX ANALYSIS | 3-1-0-4 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

**COURSE OBJECTIVES**

- To equip the students with methods of solving a general system of linear equations.
- To familiarize them with the concept of Eigen values and diagonalization of a matrix which have many applications in Engineering.
- To understand the basic theory of functions of a complex variable and conformal Transformations**.**

**Syllabus**

Analyticity of complex functions-Complex differentiation-Conformal mappings-Complex integration-System of linear equations-Eigen value problem

**Expected outcome** .

At the end of the course students will be able to
(i) solve any given system of linear equations
(ii) find the Eigen values of a matrix and how to diagonalize a matrix
(iii) identify analytic functions and Harmonic functions.
(iv)evaluate real definite Integrals as application of Residue Theorem
(v) identify conformal mappings(vi) find regions that are mapped under certain Transformations

**Text Book:**

Erwin Kreyszig: Advanced Engineering Mathematics, 10th ed. Wiley

**References:**

1.Dennis g Zill&Patric D Shanahan-A first Course in Complex Analysis with Applications-Jones&Bartlet Publishers
2.B. S. Grewal. Higher Engineering Mathematics, Khanna Publishers, New Delhi.
3.Lipschutz, Linear Algebra,3e **(** Schaums **Series)**McGraw Hill Education India 2005
4.Complex variables introduction and applications-second edition-Mark.J.Owitz-Cambridge Publication

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Complex differentiation Text 1[13.3,13.4]<br>Limit, continuity and derivative of complex functions | 3 | |
| | Analytic Functions | 2 | |
| | Cauchy–Riemann Equation(Proof of sufficient condition of analyticity & C R Equations in polar form not required)-Laplace's Equation | 2 | |
| | Harmonic functions, Harmonic Conjugate | 2 | 15% |
| II | Conformal mapping: Text 1[17.1-17.4]<br>Geometry of Analytic functions Conformal Mapping, | 1 | |
| | Mapping $w = z^2$ conformality of $w = e^z$. | 2 | 15% |

| | | | |
|---|---|---|---|
| | The mapping $w = z + \frac{1}{z}$<br>Properties of $w = \frac{1}{z}$<br>Circles and straight lines, extended complex plane, fixed points<br>Special linear fractional Transformations, Cross Ratio, Cross Ratio property-Mapping of disks and half planes<br>Conformal mapping by $w = \sin z$ & $w = \cos z$<br>(Assignment: Application of analytic functions in Engineering) | 1<br>3<br>3 | |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | Complex Integration. Text 1[14.1-14.4] [15.4&16.1]<br>Definition Complex Line Integrals, First Evaluation Method, Second Evaluation Method<br>Cauchy's Integral Theorem(without proof), Independence of path(without proof), Cauchy's Integral Theorem for Multiply Connected Domains (without proof)<br>Cauchy's Integral Formula- Derivatives of Analytic Functions(without proof)Application of derivative of Analytical Functions<br>Taylor and Maclaurin series(without proof), Power series as Taylor series, Practical methods(without proof)<br>Laurent's series (without proof) | 2<br>2<br>2<br>2<br>2 | 15% |
| **IV** | Residue Integration Text 1 [16.2-16.4]<br>Singularities, Zeros, Poles, Essential singularity, Zeros of analytic functions<br>Residue Integration Method, Formulas for Residues, Several singularities inside the contour Residue Theorem.<br>Evaluation of Real Integrals (i) Integrals of rational functions of $\sin\theta$ and $\cos\theta$ (ii)Integrals of the type $\int_{-\infty}^{\infty} f(x)dx$ (Type I, Integrals from 0 to $\infty$ )<br>( Assignment : Application of Complex integration in Engineering) | 2<br>4<br>3 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Linear system of Equations Text 1(7.3-7.5)<br>Linear systems of Equations, Coefficient Matrix, Augmented Matrix<br>Gauss Elimination and back substitution, Elementary row operations, Row equivalent systems, Gauss elimination-Three possible cases, Row Echelon form and Information from it. | 1<br>5 | 20% |

| | | | |
|---|---|---|---|
| | Linear independence-rank of a matrix<br>Vector Space-Dimension-basis-vector space$\mathbf{R}^3$<br>Solution of linear systems, Fundamental theorem of non-homogeneous linear systems(Without proof)-Homogeneous linear systems (Theory only | 2<br>1 | |
| **VI** | Matrix Eigen value Problem Text 1.(8.1,8.3 &8.4)<br>Determination of Eigen values and Eigen vectors-Eigen space<br>Symmetric, Skew Symmetric and Orthogonal matrices –simple properties (without proof)<br>Basis of Eigen vectors- Similar matrices Diagonalization of a matrix-Quadratic forms- Principal axis theorem(without proof)<br>(Assignment-Some applications of Eigen values(8.2)) | 3<br>2<br>4 | 20% |
| **END SEMESTER EXAM** | | | |

**QUESTION PAPER PATTERN:**

Maximum Marks : 100 Exam Duration: 3 hours

The question paper will consist of 3 parts.

Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.

| Course No. | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| MA202 | Probability distributions, Transforms and Numerical Methods | 3-1-0-4 | 2016 |

**Prerequisite: Nil**

**Course Objectives**

- To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in various Engineering and social life situations.
- To know Laplace and Fourier transforms which has wide application in all Engineering courses.
- To enable the students to solve various engineering problems using numerical methods.

**Syllabus**

Discrete random variables and Discrete Probability Distribution.
Continuous Random variables and Continuous Probability Distribution.
Fourier transforms.
Laplace Transforms.
Numerical methods-solution of Algebraic and transcendental Equations, Interpolation.
Numerical solution of system of Equations. Numerical Integration, Numerical solution of ordinary differential equation of First order.

**Expected outcome** .

After the completion of the course student is expected to have concept of
(i) Discrete and continuous probability density functions and special probability distributions.
(ii) Laplace and Fourier transforms and apply them in their Engineering branch
(iii) numerical methods and their applications in solving Engineering problems.

**Text Books:**

1. Miller and Freund's "Probability and statistics for Engineers"-Pearson-Eighth Edition.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.

**References:**

1. V. Sundarapandian, "Probability, Statistics and Queuing theory", PHI Learning, 2009.
2. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics"-Sixth Edition.
3. Jay L. Devore, "Probability and Statistics for Engineering and Science"-Eight Edition.
4. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers"-Sixth Edition-Mc Graw Hill.

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | **Discrete Probability Distributions.** (Relevant topics in section 4.1,4,2,4.4,4.6 Text1 ) | | |
| | Discrete Random Variables, Probability distribution function, Cumulative distribution function. | 2 | |
| | Mean and Variance of Discrete Probability Distribution. | 2 | |
| | Binomial Distribution-Mean and variance. | 2 | |
| | Poisson Approximation to the Binomial Distribution. Poisson distribution-Mean and variance. | 2 | 15% |

| | | | |
|---|---|---|---|
| **II** | **Continuous Probability Distributions.** (Relevant topics in section 5.1,5.2,5.5,5.7 Text1)<br>Continuous Random Variable, Probability density function, Cumulative density function, Mean and variance.<br>Normal Distribution, Mean and variance (without proof).<br>Uniform Distribution.Mean and variance.<br>Exponential Distribution, Mean and variance. | <br>2<br><br>4<br>2<br>2 | <br><br><br><br><br>15% |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | **Fourier Integrals and transforms. (**Relevant topics in section 11.7, 11.8, 11.9 Text2)<br>Fourier Integrals. Fourier integral theorem (without proof).<br>Fourier Transform and inverse transform.<br>Fourier Sine & Cosine Transform, inverse transform. | <br>3<br>3<br>3 | 15% |
| **IV** | **Laplace transforms. (**Relevant topics in section 6.1,6.2,6.3,6.5,6.6 Text2**)**<br>Laplace Transforms, linearity, first shifting Theorem.<br>Transform of derivative and Integral, Inverse Laplace transform, Solution of ordinary differential equation using Laplace transform.<br>Unit step function, second shifting theorem.<br>Convolution Theorem (without proof).<br>Differentiation and Integration of transforms. | <br>3<br>4<br>2<br>2<br>2 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | **Numerical Techniques**.( Relevant topics in section.19.1,19.2,19.3 Text2)<br>Solution Of equations by Iteration, Newton- Raphson Method.<br>Interpolation of Unequal intervals-Lagrange's Interpolation formula.<br>Interpolation of Equal intervals-Newton's forward difference formula, Newton's Backward difference formula. | <br>2<br>2<br>3 | 20% |
| **VI** | **Numerical Techniques**. ( Relevant topics in section 19.5,20.1,20.3, 21.1 Text2)<br>Solution to linear System- Gauss Elimination, Gauss Seidal Iteration Method.<br>Numeric Integration-Trapezoidal Rule, Simpson's 1/3 Rule.<br>Numerical solution of firstorder ODE-Euler method, Runge-Kutta Method (fourth order). | <br>3<br>3<br>3 | 20% |
| **END SEMESTER EXAM** | | | |

**QUESTION PAPER PATTERN:**

Maximum Marks : 100 Exam Duration: 3 hours

The question paper will consist of 3 parts.

Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.

| Course Number | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| ME200 | Fluid mechanics and Machinery | 3-1-0-4 | 2016 |

**Prerequisite : Nil**

**Course Objectives:**

- To introduce students, the fundamental concepts related to the mechanics of fluids.
- To understand the basic principles of fluid machines and devices.
- To apply acquired knowledge on real life problems.
- To analyze existing fluid systems and design new fluid systems.

**Syllabus**

Fundamental Concepts, fluid statics and dynamics, fluid kinematics, boundary layer theory, hydraulic turbines, positive displacement pumps, rotary motion of liquids**,** centrifugal pump, pumping devices.

**Expected Outcome**

Up on completion of course the students might be in a position to:

i. Analyze flow problems associated with statics, kinematics and dynamics of fluids.
ii. Design and analyze fluid devices such as water turbines and pumps.
iii. Understand and rectify problems faced in practical cases of engineering applications.

**Text Book:**

1. Modi P. N. and S. M. Seth, *Hydraulics & Fluid Mechanics*, S.B.H Publishers, New Delhi, 2002.
2. Kumar D. S., *Fluid Mechanics and Fluid Power Engineering,* S. K. Kataria & Sons, New Delhi, 1998.

**References:**

1. J. F. Douglas, “Fluid Mechanics”, Pearson education.
2. Cengel Y. A. and J. M. Cimbala, Fluid Mechanics, Tata McGraw Hill, 2013
3. Robert W. Fox and Mc Donald, “Introduction to fluid dynamics”, John Wiley and sons
4. K. Subrahmanya, “Theory and applications of fluid mechanics”, (TMH)
5. Shames. I. H, “Mechanics of fluids”.
6. Jagadish Lal, “Fluid mechanics and Hydraulic machines”.
7. R K Bansal, “Hydraulic Machines”

**Course Plan**

| Module | Contents | Hours | Sem. exam marks |
|---|---|---|---|
| I | **Fundamental concepts:** Properties of fluid - density, specific weight, viscosity, surface tension, capillarity, vapour pressure, bulk modulus, compressibility, velocity, rate of shear strain, Newton’s law of viscosity, Newtonian and non-Newtonian fluids, real and ideal fluids, incompressible and compressible fluids. | 6 | 15% |

| | | | |
|---|---|---|---|
| II | **Fluid statics:** Atmospheric pressure, gauge pressure and absolute pressure. Pascal's Law, measurement of pressure - piezo meter, manometers, pressure gauges, energies in flowing fluid, head - pressure, dynamic, static and total head, forces on planar and curved surfaces immersed in fluids, centre of pressure, buoyancy, equilibrium of floating bodies, metacentre and metacentric height. | 10 | 15% |
| **First Internal Exam** | | | |
| III | **Fluid kinematics and dynamics:** Classification of flow -1D, 2D and 3D flow, steady, unsteady, uniform, non-uniform, rotational, irrotational, laminar and turbulent flow, path line, streak line and stream line.<br>Continuity equation, Euler's equation, Bernoulli's equation. Reynolds experiment, Reynold's number. Hagen- Poiseuille equation, head loss due to friction, friction, Darcy- Weisbach equation, Chezy's formula, compounding pipes, branching of pipes, siphon effect, water hammer transmission of power through pipes (simple problems) | 8 | 15% |
| IV | **Boundary layer theory:** Basic concepts, laminar and turbulent boundary layer, displacement, momentum, energy thickness, drag and lift, separation of boundary layer.<br>Flow rate measurements- venturi and orifice meters, notches and weirs (description only for notches, weirs and meters), practical applications, velocity measurements- Pitot tube and Pitot –static tube. | 10 | 15% |
| **Second Internal Exam** | | | |
| V | **Hydraulic turbines :** Impact of jets on vanes - flat, curved, stationary and moving vanes - radial flow over vanes. Impulse and Reaction Turbines – Pelton Wheel constructional features - speed ratio, jet ratio & work done , losses and efficiencies, inward and outward flow reaction turbines- Francis turbine constructional features, work done and efficiencies – axial flow turbine (Kaplan) constructional features, work done and efficiencies, draft tubes, surge tanks, cavitation in turbines. | 10 | 20% |
| VI | **Positive displacement pumps:** reciprocating pump, indicator diagram, air vessels and their purposes, slip, negative slip and work required and efficiency, effect of acceleration and friction on indicator diagram (no derivations), multi cylinder pumps.<br><br>**Rotary motion of liquids:** – free, forced and spiral vortex flows, (no derivations), centrifugal pump, working principle, impeller, casings, manometric head, work, efficiency and losses, priming, specific speed, multistage pumps, selection of pumps, pump characteristics. | 10 | 20% |
| **End Semester Exam** | | | |

## Question Paper Pattern

Max. marks: 100, Time: 3 hrs

The question paper should consist of three parts

**Part A**

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note**: In all parts, each question can have a maximum of four sub questions, if needed.

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| ME201 | MECHANICS OF SOLIDS | 3-1-0-4 | 2016 |

**Prerequisite: nil**

**Course Objectives:**

1. To acquaint with the basic concepts of stress and deformation in solids.
2. To practice the methodologies to analyse stresses and strains in simple structural members, and to apply the results in simple design problems.

**Syllabus**

Analysis of deformable bodies : stress, strain, material behaviour, deformation in axially loaded bars, biaxial and triaxial deformation. Torsion of elastic circular members, design of shafts. Axial force, shear force and bending moment in beams. Stresses in beams: flexure and shear stress formulae, design of beams. Deflection of beams. Transformation equations for plane state of stress and strain, principal planes and stresses, Mohr's circle. Compound stresses: combined axial, flexural and shear loads – eccentric loading. Buckling: Euler's theory and Rankine's formula for columns.

**Expected outcomes:** At the end of the course students will be able to

1. Understand basic concepts of stress and strain in solids.
2. Determine the stresses in simple structural members such as shafts, beams, columns etc. and apply these results in simple design problems.
3. Determine principal planes and stresses, and apply the results to combined loading case.

**Text Books**:


1. Rattan, Strength of Materials, 2e McGraw Hill Education India, 2011
2. S.Jose, Sudhi Mary Kurian, Mechanics of Solids, Pentagon, 2015


**References Books**:


1. S. H. Crandal, N. C. Dhal, T. J. Lardner, An introduction to the Mechanics of Solids, McGraw Hill, 1999
2. R. C. Hibbeler, Mechanics of Materials, Pearson Education,2008
3. I.H. Shames, J. H. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, 2006
4. James M.Gere, Stephen Timoshenko, Mechanics of Materials, CBS Publishers & Distributors, New Delhi,2012
5. F. Beer, E. R. Johnston, J. T. DeWolf, Mechanics of Materials, Tata McGraw Hill, 2011
6. A. Pytel, F. L. Singer, Strength of Materials, Harper & Row Publishers, New York,1998
7. E. P. Popov, T. A. Balan, Engineering Mechanics of Solids, Pearson Education, 2012
8. R. K. Bansal, Mechanics of solids, Laxmi Publications, 2004
9. P. N. Singh, P. K. Jha, Elementary Mechanics of Solids, Wiley Eastern Limited, 2012

| Course Plan | | | |
|---|---|---|---|
| **Module** | **Contents** | **Hours** | **Sem. Exam Marks** |
| **I** | Introduction to analysis of deformable bodies – internal forces – method of sections – assumptions and limitations. Stress – stresses due to normal, shear and bearing loads – strength design of simple members. Definition of linear and shear strains. | 3 | 15% |
| | Material behavior – uniaxial tension test – stress-strain diagrams concepts of orthotropy, anisotropy and inelastic behavior – Hooke's law for linearly elastic isotropic material under axial and shear deformation | 3 | |
| | Deformation in axially loaded bars – thermal effects – statically indeterminate problems – principle of superposition - elastic strain energy for uniaxial stress. | 4 | |
| **II** | Definition of stress and strain at a point (introduction to stress and strain tensors and its components only) – Poisson's ratio – biaxial and triaxial deformations – Bulk modulus - Relations between elastic | 4 | 15% |
| | Torsion: Shafts - torsion theory of elastic circular bars – assumptions and limitations – polar modulus - torsional rigidity – economic cross-sections – statically indeterminate problems – shaft design for torsional load. | 4 | |
| **FIRST INTERNAL EXAM** | | | |
| **III** | Beams- classification - diagrammatic conventions for supports and loading - axial force, shear force and bending moment in a beam | 2 | 15% |
| | Shear force and bending moment diagrams by direct approach | 3 | |
| | Differential equations between load, shear force and bending moment. Shear force and bending moment diagrams by summation approach – elastic curve – point of inflection. | 5 | |
| **IV** | Stresses in beams: Pure bending – flexure formula for beams assumptions and limitations – section modulus - flexural rigidity - economic sections – beam of uniform strength. | 4 | 15% |
| | Shearing stress formula for beams – assumptions and limitations – design for flexure and shear. | 4 | |
| **SECOND INTERNAL EXAM** | | | |
| **V** | Deflection of beams: Moment-curvature relation – assumptions and limitations - double integration method – Macaulay's method - superposition techniques – moment area method and conjugate beam ideas for simple cases. | 6 | 20% |
| | Transformation of stress and strains: Plane state of stress - equations of transformation - principal planes and stresses. | 4 | |
| **VI** | Mohr's circles of stress – plane state of strain – analogy between stress and strain transformation – strain rosettes | 3 | 20% |
| | Compound stresses: Combined axial, flexural and shear loads – eccentric loading under tension/compression - combined bending and twisting loads. | 4 | |

| | | | |
|---|---|---|---|
| | Theory of columns: Buckling theory –Euler's formula for long columns – assumptions and limitations – effect of end conditions - slenderness ratio – Rankin's formula for intermediate columns. | 3 | |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

Total marks: 100, Time: 3 hrs
The question paper should consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

| Course No. | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| ME230 | FLUID MECHANICS AND MACHINES LABORATORY | 0-0-3-1 | 2016 |

**Prerequisite:** ME203 Mechanics of fluids

**Course Objectives:** The main objectives of this course is to demonstrate the applications of theories of basic fluid mechanics and hydraulic machines and to provide a more intuitive and physical understanding of the theory.

**Syllabus**

**Study:**

1. Study of flow measuring equipments - water meters, venturi meter, orifice meter, current meter, rotameter
2. Study of gauges - pressure gauge, vacuum gauge, manometers.
3. Study of valves - stop valve, gate valve and foot valve.
4. Study of pumps – Centrifugal, Reciprocating, Rotary, Jet.
5. Study of Turbines - Impulse and reaction types.
6. Study of Hydraulic ram, accumulator etc.

**List of Experiments:**

1. Determination of coefficient of discharge and calibration of Notches
2. Determination of coefficient of discharge and calibration of Orifice meter
3. Determination of coefficient of discharge and calibration of Venturimeter.
4. Determination of Chezy's constant and Darcy's coefficient on pipe friction apparatus
5. Determination of hydraulic coefficients of orifices
6. Determination of metacentric height and radius of gyration of floating bodies.
7. Experiments on hydraulic ram
8. Reynolds experiment
9. Bernoulli's experiment
10. Experiment on Torque converter
11. Performance test on positive displacement pumps
12. Performance test on centrifugal pumps, determination of operating point and efficiency
13. Performance test on gear pump
14. Performance test on Impulse turbines
15. Performance test on reaction turbines (Francis and Kaplan Turbines)
16. Speed variation test on Impulse turbine
17. Determination of best guide vane opening for Reaction turbine
18. Impact of jet

Note: 12 experiments are mandatory

Expected outcome: At the end of the course the students will be able to

1. Discuss physical basis of Bernoulli's equation, and apply it in flow measurement (orifice, Nozzle and Venturi meter), and to a variety of problems
2. Determine the efficiency and plot the characteristic curves of different types of pumps and turbines.

| Course code | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| ME302 | Heat and Mass Transfer | 3-1-0-4 | 2016 |

**Prerequisites : ME203 Mechanics of fluid**

**Course Objectives:**

- To introduce the various modes of heat transfer and to develop methodologies for solving a wide variety of practical heat transfer problems
- To provide useful information concerning the performance and design of simple heat transfer systems
- To introduce mass transfer

**Syllabus:**

Modes of Heat Transfer: Conduction: Most general heat conduction equation, One dimensional steady state conduction with and without heat generation, Critical radius of insulation, Elementary ideas of hydrodynamics and thermal boundary layers, Convection heat transfer: Newton's law of cooling, Dimensionless numbers, Dimensional analysis, Problems. Fins: Types of fins : Fin efficiency and effectiveness. Boiling and condensation heat transfer, Introduction to heat pipe. Transient heat conduction. Heat exchangers, LMTD and NTU methods. Radiation: laws of radiation, Electrical analogy, Radiation shields. Mass Transfer :Mass transfer by molecular diffusion, Convective mass transfer.

**Expected outcome:**

The students will be able to

1. Apply principles of heat and mass transfer to engineering problems
2. Analyse and obtain solutions to problems involving various modes of heat transfer
3. Design heat transfer systems such as heat exchangers, fins, radiation shields etc..

**Text Books**:


1. Sachdeva R C, Fundamentals of Engineering Heat and Mass Transfer, New Age Science Limited, 2009
2. R.K.Rajput. Heat and mass transfer, S.Chand& Co.,2015
3. Nag P K., Heat and Mass Transfer, McGraw Hill,2011
4. Kothandaraman, C.P., Fundamentals of Heat and Mass Transfer, New Age International, New Delhi, 2006


**Data Book:**

- Heat and Mass Transfer data book: C.P. Kothandaraman, S. Subramanya, New age International publishers,2014

**References Books:**


1. Yunus A Cengel, Heat Transfer: A Practical Approach, McGraw Hill,2015
2. Holman J P, Heat Transfer, McGraw Hill, 2011
3. Frank P. Incropera and David P. Dewitt, Heat and Mass Transfer, John Wiley and sons, 2011

| Course Plan | | | |
|---|---|---|---|
| **Module** | **Contents** | **Hours** | **End Sem. Exam Marks** |
| **I** | Modes of Heat Transfer: Conduction: Fourier law of heat conduction-Thermal conductivity of solids, liquids and gases-Factors affecting thermal conductivity- Most general heat conduction equation in Cartesian, cylindrical and spherical coordinates One dimensional steady state conduction with and without heat generation conduction through plane walls, cylinders and spheres-variable thermal conductivity conduction shape factor- heat transfer through corners and edges. Critical radius of insulation. | 12 | 15% |
| **II** | Elementary ideas of hydrodynamics and thermal boundary layers-Thickness of Boundary layer-Displacement, Momentum and Energy thickness (description only).<br>Convection heat transfer: Newton's law of cooling- Laminar and Turbulent flow, Reynolds Number, Critical Reynolds Number, Prandtl Number, Nusselt Number, Grashoff Number and Rayleigh's Number. Dimensional analysis Buckingham's Pi theorem- Application of dimensional analysis to free and forced convection- empirical relations- problems using empirical relations | 10 | 15% |
| **FIRST INTERNAL EXAMINATIONEXAM** | | | |
| **III** | Transient heat conduction-lumped heat capacity method. Fins: Types of fins - Heat transfer from fins of uniform cross sectional area- Fin efficiency and effectiveness. Boiling and condensation heat transfer(elementary ideas only),Introduction to heat pipe. | 8 | 15% |
| **IV** | Combined conduction and convection heat transfer-Overall heat transfer coefficient - Heat exchangers: Types of heat exchangers, AMTD, Fouling factor, Analysis of Heat exchangers- LMTD method, Correction factor, Effectiveness-NTU method, Special type of heat exchangers (condenser and evaporator, simple problems only) | 8 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Radiation- Nature of thermal radiation-definitions and concepts- monochromatic and total emissive power-Intensity of radiation- solid angle- absorptivity, reflectivity and transmissivity-Concept of black body- Planck' law- Kirchoff's law- Wein's displacement law-Stefan Boltzmann's law- black, gray and real surfaces-Configuration factor (derivation for simple geometries only)- Electrical analogy- Heat exchange between black/gray surfaces- infinite parallel plates, equal and parallel opposite plates-perpendicular rectangles having common edge- parallel discs (simple problems using charts and tables). Radiation shields(no derivation). | 10 | 20% |

| | | | |
|---|---|---|---|
| **VI** | Mass Transfer :Mass transfer by molecular diffusion- Fick's law of diffusion- diffusion coefficient Steady state diffusion of gases and liquids through solid- equimolar diffusion, Isothermal evaporation of water through air- simple problems.<br>Convective mass transfer- Evaluation of mass transfer coefficient- empirical relations- simple problems- analogy between heat and mass transfer. | 8 | 20% |
| **END SEMESTER EXAM** | | | |



**Question Paper Pattern**

*Use of approved data book permitted*

Total marks: 100, Time: 3 hrs

The question paper should consist of three parts

**Part A**

There should be 2 questions each from module I and II

Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

There should be 2 questions each from module III and IV

Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

There should be 3 questions each from module V and VI

Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.

| Course code | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| ME304 | DYNAMICS OF MACHINERY | 2-1-0-3 | 2016 |

**Prerequisite: ME301 Mechanics of Machinery**

**Course Objectives:**

- To impart knowledge on force analysis of machinery, balancing of rotating and reciprocating masses, Gyroscopes, Energy fluctuation in Machines.
- To introduce the fundamentals in vibration, vibration analysis of single degree of freedom systems.
- To understand the physical significance and design of vibration systems with desired conditions

**Syllabus**

Force analysis of machinery - static and dynamic force analysis of plane motion mechanisms. Flywheel analysis - static and dynamic balancing - balancing of rotating masses, gyroscopic couples. Vibrations – free vibrations of single degree freedom systems, damping, forced vibration, torsional vibration.

**Expected outcome:**

The students will be able to

1. Develop the design and practical problem solving skills in the area of mechanisms
2. Understand the basics of vibration and apply the concepts in design problems of mechanisms.

**Text Books**:

1. Ballaney P.L. Theory of Machines, Khanna Publishers,1994
2. S. S. Rattan, Theory of Machines, Tata McGraw Hill, 2009
3. V. P. Singh, Theory of Machines, Dhanpat Rai,2013

**References :**


1. E. Wilson, P. Sadler, Kinematics and Dynamics of Machinery, Pearson Education, 2003
2. Ghosh, A. K. Malik, Theory of Mechanisms and Machines, Affiliated East West Press, 2003
3. H. Myskza, Machines and Mechanisms Applied Kinematic Analysis, Pearson Education, 4e, 2012
4. Holowenko, Dynamics of Machinery, John Wiley, 1995
5. J. E. Shigley, J. J. Uicker, Theory of Machines and Mechanisms, McGraw Hill,1995
6. W.T.Thompson, Theory of vibration, Prentice Hall,1997

| Course Plan | | | |
|---|---|---|---|
| **Module** | **Contents** | **Hours** | **End Sem. Exam Marks** |
| **I** | Introduction to force analysis in mechanisms - static force analysis (four bar linkages only) - graphical methods | 4 | 15% |
| | Matrix methods - method of virtual work - analysis with sliding and pin friction | 3 | |
| **II** | Dynamic force analysis: Inertia force and inertia torque. D'Alemberts principle, analysis of mechanisms (four bar linkages only), equivalent dynamical systems | 4 | 15% |
| | Force Analysis of spur- helical - bevel and worm gearing | 3 | |
| **FIRST INTERNAL EXAM** | | | |
| **III** | Flywheel analysis - balancing - static and dynamic balancing - balancing of masses rotating in several planes | 4 | 15% |
| | Balancing of reciprocating masses - balancing of multi-cylinder in line engines - V engines - balancing of machines | 3 | |
| **IV** | Gyroscope – gyroscopic couples | 3 | 15% |
| | Gyroscopic action on vehicles-two wheelers, four wheelers, air planes and ships. Stability of an automobile – stability of a two wheel vehicle –Stabilization of ship. | 4 | |
| **SECOND INTERNAL EXAM** | | | |
| **V** | Introduction to vibrations – free vibrations of single degree freedom systems – energy Method | 2 | 20% |
| | Undamped and damped free vibrations – viscous damping – critical damping - logarithmic decrement - Coulomb damping – harmonically excited vibrations | 3 | |
| | Response of an undamped and damped system – beat phenomenon - transmissibility | 2 | |
| **VI** | Whirling of shafts – critical speed - free torsional vibrations – self excitation and stability analysis - vibration control - vibration isolation – vibration absorbers | 4 | 20% |
| | Introduction to multi-degree freedom systems - vibration measurement - accelerometer – seismometer – vibration exciters | 3 | |
| **END SEMESTER EXAM** | | | |

**Question Paper Pattern**

**Maximum marks: 100** **Time: 3 hrs**

The question paper should consist of three parts

**Part A**
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| ME307 | MACHINE DESIGN - I | 3-1-0-4 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To understand the basic components and layout of linkages in the assembly of a system/machine.

**Syllabus**

Introduction to design of riveted, threaded, and welded joints – springs and design –Design laws – stresses in components and machines.

**Expected outcome**.

- The students will become aware of the machine components, forces, stresses affecting them and the aspects of designing them.

**Text Books:**

1. R L Norton, Kinematics and Dynamics of Machinery, 1st ed., Tata McGraw Hill Education Private Limited, Delhi, 2004
2. S .S Rattan Theory of Machines, 3rd ed., Tata McGraw Hill Education Private Limited, Delhi, 2009

**References:**

1. J. E. Shigley, J. J. Uicker, Theory of Machines and Mechanisms, Oxford University Press, 2016
2. A. Ghosh, A. K. Malik, Theory of Mechanisms and Machines, Affiliated East West Press, 3e, 2006
3. C. E. Wilson, P. Sadler, Kinematics and Dynamics of Machinery, 3rd edition, Pearson Education, 2003
4. Holowenko, Dynamics of Machinery, John Wiley & Sons, 1995

**Course Plan**

| Module | Contents | Hours | End Sem. Exam Marks |
|---|---|---|---|
| I | Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law –Kinematic inversions of four-bar chain, slider crank chains and double slider crank chains – Limit positions –Mechanical advantage – Transmission Angle -Coupler curves – Description of some common Mechanisms – Quick return mechanisms, Straight line generators | 10 | 15% |
| II | Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method – Velocity and acceleration polygons **Force analysis of machinery** - static and dynamic force analysis of plane motion mechanisms - graphical method - principle of superposition –matrix methods - method of virtual work. | 10 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Governors: - terminology and classification ; Watt, Porter, Proel, Hartnell, Hartung, quality of governors,inertia governors- governor speed control<br>Gyroscope: - Principle-Angular acceleration-Effect of gyroscopic | 8 | 15% |

| | | | |
|---|---|---|---|
| | couple airplanes, and ships, stability of automobile and two wheel vehicles, Rigid disc at an angle fixed to a rotating shaft | | |
| **IV** | Turning moment diagram and Flywheel: - coefficient of fluctuation of energy and speed- energy saved in a flywheel- force analysis, piston effort-crankpin effort- crank effort-turning moment diagrams for I.C. engines. | 8 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Cams and Followers: - types-follower motion-SHM-uniform velocity and acceleration- Cycloidal - displacement, velocity and acceleration curves-Cam profile-Reciprocating and oscillating followers-Tangent cams-Convex and concave cams with footed followers. Introduction to Polynomial cams. (Numerical problems) | 10 | 20% |
| **VI** | Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting<br>Gear trains – Speed ratio, train value – Parallel axis gear trains– Epicyclic Gear Trains (Numerical problems) | 10 | 20% |
| **END SEMESTER EXAM** | | | |

## QUESTION PAPER PATTERN

Maximum Marks :100 Exam Duration: 3 Hours

**PART A**

4 Questions uniformly covering modules 1 and 2. Each question carries 10 marks. Students will have to answer any three questions out of four. (3X10=30 marks)

**PART B**

4 Questions uniformly covering modules 3 and 4. Each question carries 10 marks. Students will have to answer any three questions out of four. (3X10=30 marks)

**PART C**

6 Questions uniformly covering modules 5 and 6. Each question carries 10 marks. Students will have to answer any four questions out of six. (4X10=40 marks)

**Note:** Each question can have maximum of 4 sub questions ( a, b, c, d)

| Course code | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| ME309 | METALLURGY AND MATERIALS SCIENCE | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives:**

- To provide physical concepts of atomic radius, atomic structure, chemical bonds, crystalline and non-crystalline materials and defects of crystal structures, grain size, strengthening mechanisms, heat treatment of metals with mechanical properties and changes in structure
- To makee aware of the behavior of materials in engineering applications and select the materials for various engineering applications.
- To understand the causes behind metal failure and deformation
- To determine properties of unknown materials and develop an awareness to apply this knowledge in material design

**Syllabus**

Chemical bonds – crystallography- imperfections- crystallization- diffusion- phase diagrams-heat treatment – strengthening mechanisms- hot and cold working – alloying- ferrous and non ferrous alloys- fatigue-creep- basics, need, properties and applications of modern engineering materials.

**Expected outcome:**

The students will be able to

i. Identify the crystal structures of metallic materials.
ii. Analyze the binary phase diagrams of alloys Fe-Fe3C, etc.
iii. Correlate the microstructure with properties, processing and performance of metals.
iv. Recognize the failure of metals with structural change.
v. Select materials for design and construction.
vi. Apply core concepts in materials science to solve engineering problems.

**Text Books**


1. Jose S and Mathew E V, Metallurgy and Materials Science, Pentagon, 2011
2. Raghavan V, Material Science and Engineering, Prentice Hall,2004


**References**


1. Anderson J.C. *et.al*., Material Science for Engineers,Chapman and Hall,1990
2. Avner H Sidney, Introduction to Physical Metallurgy, Tata McGraw Hill, 2009
3. Callister William. D., Material Science and Engineering, John Wiley, 2014
4. Clark and Varney, Physical metallurgy for Engineers, Van Nostrand,1964
5. Dieter George E, Mechanical Metallurgy, Tata McGraw Hill,1976
6. Higgins R.A. - Engineering Metallurgy part - I – ELBS,1998
7. Myers Marc and Krishna Kumar Chawla, Mechanical behaviour of materials, Cambridge University press,2008
8. Reed Hill E. Robert, Physical metallurgy principles, 4th Edn. Cengage Learning, 2009
9. Van Vlack -Elements of Material Science - Addison Wesley,1989
10. http://nptel.ac.in/courses/113106032/1
11. http://www.myopencourses.com/subject/principles-of-physical-metallurgy-2
12. http://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-tosolid- State-chemistry-fall-2010/syllabus/
13. http://www.msm.cam.ac.uk/teaching/partIA.php

| COURSE PLAN | | | |
|---|---|---|---|
| **Module** | **Contents** | **Hours** | **End Sem. Exam Marks** |
| **I** | Earlier and present development of atomic structure; attributes of ionization energy and conductivity, electronegativity and alloying; correlation of atomic radius to strength; electron configurations; electronic repulsion Primary bonds: - characteristics of covalent, ionic and metallic bond: attributes of bond energy, cohesive force, density, directional and non-directional and ductility, properties based on atomic bonding:- attributes of deeper, energy well and shallow energy well to melting, temperature, coefficient of thermal expansion - attributes of modulus of elasticity in metal cutting process – Secondary bonds:- classification- hydrogen bond and anomalous behavior of ice float on water, application- atomic mass unit and specific heat, application. *(brief review only, no Universityquestions and internal assessment from these portions.)* | **2** | **15%** |
| | Crystallography:- Crystal, space lattice, unit cell- BCC, FCC, HCP structures - short and long range order – effects of crystalline and amorphous structure on mechanical properties. | 1 | |
| | Coordination number and radius ratio; theoretical density; simple problems - Polymorphism and allotropy. | 1 | |
| | Miller Indices: - crystal plane and direction (brief review) - Attributes of miller indices for slip system, brittleness of BCC, HCP and ductility of FCC - Modes of plastic deformation: - Slip and twinning. | 1 | |
| | Schmid's law, equation, critical resolved shear stress,correlation of slip system with plastic deformation in metals and applications. | 1 | |
| **II** | Mechanism of crystallization:Homogeneous and heterogeneous nuclei formation, under cooling, dendritic growth, grain boundary irregularity. | 1 | 15% |
| | Effects of grain size, grain size distribution, grain shape, grain orientation on dislocation/strength and creep resistance - Hall - Petch theory, simple problems | 1 | |
| | Classification of crystal imperfections: - types of dislocation – effect of point defects on mechanical properties - forest of dislocation, role of surface defects on crack initiation. | 1 | |
| | Burgers vector –dislocation source, significance of Frank Read source in metals deformation - Correlation of dislocation density with strength and nano concept, applications. | 1 | |
| | Significance high and low angle grain boundaries on dislocation – driving force for grain growth and applications during heat treatment. | 1 | |
| | Polishing and etching to determine the microstructure and grain size. | 1 | |
| | Fundamentals and crystal structure determination by X – ray diffraction, simple problems –SEM and TEM. | 1 | |
| | Diffusion in solids, Fick's laws, mechanisms, applications of diffusion in mechanical engineering, simple problems. | 1 | |
| **FIRST INTERNAL EXAMINATION** | | | |

| | | | |
|---|---|---|---|
| **III** | Phase diagrams: - Limitations of pure metals and need of alloying - classification of alloys, solid solutions, Hume Rothery`s rule - equilibrium diagram of common types of binary systems: five types. | 2 | 15% |
| | Coring - lever rule and Gibb`s phase rule - Reactions: monotectic, eutectic, eutectoid, peritectic, peritectoid. | 1 | |
| | Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties changes in austenite, ledeburite, ferrite, cementite, special features of martensite, transformation, bainite, spheroidite etc. | 1 | |
| | Heat treatment: - Definition and necessity – TTT for eutectoid iron–carbon alloy, CCT diagram, applications - annealing, normalizing, hardening, spheroidizing. | 1 | |
| | Tempering:- austermpering, martempering and ausforming- Comparative study on ductility and strength with structure of pearlite, bainite, spherodite, martensite, tempered martensite and ausforming. | 1 | |
| | Hardenability, Jominy end quench test, applications- Surface hardening methods:- no change in surface composition methods :- Flame, induction, laser and electron beam hardening processes- change in surface composition methods :carburizing and Nitriding; applications. | 2 | |
| **IV** | Types of Strengthening mechanisms: - work hardening, equation - precipitation strengthening and over ageing- Dispersion hardening. | 1 | 15% |
| | Cold working: Detailed discussion on strain hardening; recovery; re-crystallization, effect of stored energy; re-crystallization temperature - hot working, Bauschinger effect and attributes in metal forming. | 1 | |
| | Alloy steels:- Effects of alloying elements on steel: dislocation movement, polymorphic transformation temperature, alpha and beta stabilizers, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties | 1 | |
| | Nickel steels, Chromium steels etc. - Enhancement of steel properties by adding alloying elements: Molybdenum, Nickel, Chromium, Vanadium, Tungsten, Cobalt, Silicon,Copper and Lead. | 1 | |
| | High speed steels:- Mo and W types, effect of different alloying elements in HSS | 1 | |
| | Cast irons: Classifications; grey, white, malleable and spheroidal graphite cast iron etc, composition, Microstructure, properties and applications. | 1 | |
| | Principal Non ferrous Alloys: - Aluminum, Copper, Magnesium, Nickel, study of composition, properties, applications, reference shall be made to the phase diagrams whenever necessary. | 1 | |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Fatigue: - Stress cycles – Primary and secondary stress raisers - Characteristics of fatigue failure, fatigue tests, S-N curve. | 1 | 20% |
| | Factors affecting fatigue strength: stress concentration, size effect, surface roughness, change in surface properties, surface residual stress. | 1 | |

| | | | |
|---|---|---|---|
| | Ways to improve fatigue life – effect of temperature on fatigue, thermal fatigue and its applications in metal cutting | 1 | |
| | Fracture: – Brittle and ductile fracture – Griffith theory of brittle fracture – Stress concentration, stress raiser – Effect of plastic deformation on crack propagation. | 1 | |
| | Transgranular, intergranular fracture - Effect of impact loading on ductile material and its application in forging, applications - Mechanism of fatigue failure. | 1 | |
| | Structural features of fatigue: - crack initiation, growth, propagation - Fracture toughness (definition only) – Ductile to brittle transition temperature (DBTT) in steels and structural changes during DBTT, applications. | 1 | |
| **VI** | Creep: - Creep curves – creep tests - Structural change: deformation by slip, sub-grain formation, grain boundary sliding | 1 | 20% |
| | Mechanism of creep deformation - threshold for creep,prevention against creep - Super plasticity: need and applications | 1 | |
| | Composites:- Need of development of composites - geometrical and spatial Characteristics of particles – classification - fiber phase: - characteristics, classifications -composites:- Need of development of composites - | 2 | |
| | Modern engineering materials: - only fundamentals, need, properties and applications of, intermetallics, maraging steel, super alloys, Titanium – introduction to nuclear materials, smart materials and bio materials. | 2 | |
| | Ceramics:-coordination number and radius ratios- AX, AmXp, AmBmXp type structures – applications. | 1 | |
| **END SEMESTER EXAMINATION** | | | |

## QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration: 3 Hrs

**PART A**
4 Questions uniformly covering modules 1 and 2. Each question carries 10 marks. Students will have to answer any three questions out of four. (3X10=30 marks)

**PART B**
4 Questions uniformly covering modules 3 and 4. Each question carries 10 marks. Students will have to answer any three questions out of four. (3X10=30 marks)

**PART C**
6 Questions uniformly covering modules 5 and 6. Each question carries 10 marks. Students will have to answer any four questions out of six. (4X10=40 marks)

**Note:** In all parts, each question can have a maximum of 4 sub questions, if needed.

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| ME311 | MANUFACTURING PROCESSES | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To introduce the different types of manufacturing processes used to create different forms of metals/alloys/composites.

**Syllabus**

Introduction to material casting processes - welding process and the physics of welding - mathematical/ physical description of forming processes – rolling and types – forging processes – advanced manufacturing – non-traditional machining – design for manufacturing

**Expected outcome**.

- The students will become aware of the types of processes used for the manufacturing the parts of automobile.

**Text Books:**

1. Helmi A Youssef, Hassan A El-Hofy and Mahmoud H Ahmed, Manufacturing Technology (materials, processes and equipments) , CRC Press, 2017
2. Kalapakjian and Schmid , Manufacturing Engineering and Technology, Pearson, 7e, 2013

**References:**

1. Hine and Rosenthal, Principles of Metal Casting , Tata McGraw Hill India, 1995
2. P.R.Beeley, Foundry Technology, Butterworths Publication, 1972

**Course Plan**

| Module | Contents | Hours | End Sem. Exam Marks |
|---|---|---|---|
| I | Casting of metallic materials – introduction – expendable mold casting processes – sand casting, shell, vacuum, slurry, plaster and ceramic molding, expandable pattern casting – permanent mold castings – die and centrifugal casting – melting furnaces – cupolas and crucible furnace –cleaning and finishing of castings – quality of castings – defects & method of inspection of defects | 7 | 15% |
| II | Bulk forming of metallic materials – Classification – Forging processes – open die, close die, special forging processes – forging equipment and defects<br>Rolling processes – flat, section, tube , and special rolling processes and rolling defects – Extrusion – classification – equipment & defects<br>Drawing – rod, wire and tube – classification and drawing die | 7 | 15% |
| FIRST INTERNAL EXAMINATION | | | |
| III | Sheet metal forming processes – Classification – Shearing processes and mechanism – Bending processes – parameters – springback and residual stresses – bending equipment – stretch forming – Deep drawing – blank holding pressure, ironing, deep drawing force, redrawing – hydroforming – spinning – | 8 | 15% |

| | | | |
|---|---|---|---|
| | conventional, flow tunneling and tube spinning. | | |
| **IV** | Joining processes – Fusion welding – gas, thermit, electric arc, resistance and high energy beam welding – Solid state welding – cold, diffusion, explosion, forge, friction, hot pressure, roll, and ultrasonic welding – Solid-liquid state welding – brazing, soldering and adhesive bonding – welding of plastics – metallurgy of welded joints – welding defects – quality control – destructive and non-destructive tests – mechanical joining. | 8 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Non-traditional machining – Jet machining – abrasive, water jet, and abrasive water jet – ultrasonic machining – USM equipment and process capabilities – Chemical milling & photochemical machining - ECM – elements, equipment and process capabilities – electrochemical grinding – EDM – sinking, milling and wire cutting – EBM – LBM – plasma arc cutting | 8 | 20% |
| **VI** | Advanced manufacturing techniques – near net shape manufacturing – metal injection molding and rapid prototyping – microfabrication technology – microcutting, microfinishing, and nonconventional micromachining – application of nano technology – sustainable and green manufacturing.<br>Manufacturing process capabilities – process selection factors – process information maps – ranking strategy – design for manufacturing – casting, sheet metal forming, die forging, welding, and assembly. | 7 | 20% |
| **END SEMESTER EXAM** | | | |

## QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration: 3 Hrs

**PART A**
4 Questions uniformly covering modules 1 and 2. Each question carries 10 marks. Students will have to answer any three questions out of four. (3X10=30 marks)

**PART B**
4 Questions uniformly covering modules 3 and 4. Each question carries 10 marks. Students will have to answer any three questions out of four. (3X10=30 marks)

**PART C**
6 Questions uniformly covering modules 5 and 6. Each question carries 10 marks. Students will have to answer any four questions out of six. (4X10=40 marks)

**Note:** In all parts, each question can have a maximum of 4 sub questions, if needed.

| Course code | Course Name | L-T-P – Credits | Year of Introduction |
|---|---|---|---|
| ME314 | MACHINE DESIGN - II | 3-0-0-3 | 2016 |

**Prerequisite : ME307 Machine design - II**

**Course Objectives**

- To introduce the design considerations needed for different types of machine components and

**Syllabus**

Introduction to design of different types of bearings, clutches, brakes – IC engine parts design – Design recommendations

**Expected outcome**.

- The students will become aware of the machine components, forces, stresses affecting them and aspects of designing them.

**Text Books:**

1. C.S,Sarma, KamleshPurohit, Design of Machine Elements Prentice Hall of India Ltd NewDelhi
2. M. F. Spotts, T. E. Shoup, Design of Machine Elements, Pearson Education, 8e, 2003
3. T. Krishna Rao, Design of machine Elements volume 2 I K International Publishing House Pvt. Ltd New Delhi, 2011
4. V.B.Bhandari, Design of Machine Elements McGraw Hill Book Company, 4e, 2016

**Data book ( permitted for reference in the University examination)**

1. K. Lingaiah , Machine Design Data hand book, Suma Publishers, Bangalore/ Tata McGraw Hill

**References:**

1. Doughtie V.L., &Vallance A.V., Design of Machine Elements, McGraw Hill Book Company, 1964
2. J. E. Shigley, Mechanical Engineering Design, McGraw Hill Book Company, 5e, 1986
3. Juvinall R.C &Marshek K.M., Fundamentals of Machine Component Design, John Wiley, 5e, 2011
4. Siegel, Maleev& Hartman, Mechanical Design of Machines, International Book Company.

**Course Plan**

| Module | Contents | Hours | End Sem. Exam Marks |
|---|---|---|---|
| I | Classification of design - Different phases in design process - design factors and considerations Engineering materials and their physical properties as applied to design - Selection of materials - Factors of safety in design – Endurance limit of materials- theories of failure - Guest's theory - Rankine's theory - St. Venant's theory - Haigh's theory - Von Mises&Hencky theory - shock and impact loads - fatigue loading - endurance limit stress- Factors affecting endurance limit - Factor of safety - creep and thermal stresses | 8 | 15% |
| II | Design of shafts on the basis of strength - Design of shaft on the basis of rigidity - Design of hollow shafts -design for static and fatigue loads- repeated loading- reversed bending<br>Design of welded joints- Representation of welds - stresses in fillet and butt welds- design for static loads - bending and torsion in welded | 7 | 15% |

| | | | |
|---|---|---|---|
| | joints- eccentrically loaded welds - design of welds for variable loads. | | |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | Clutches - friction clutches- design considerations-multiple disc clutches-cone clutch- centrifugal clutch<br>Brakes- Classification, internal expanding shoe brake, disc brake<br>Spring- Design of leaf spring, coil spring , torsion bar | 6 | 15% |
| **IV** | Design of bearings - Types - Selection of a bearing type - bearing life - Rolling contact bearings – static and dynamic load capacity - axial and radial loads - selection of bearings - dynamic equivalent load - lubrication and lubricants – viscosity<br>Journal bearings - hydrodynamic theory - design considerations - heat balance - bearing characteristic number - hydrostatic bearings. | 6 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Gears- classification- Gear nomenclature - Tooth profiles - Materials of gears - design of spur, helical, bevel gears and worm & worm wheel - Law of gearing - virtual or formative number of teeth- gear tooth failures- Beam strength - Lewis equation- Buckingham's equation for dynamic load | 8 | 20% |
| **VI** | Design of Internal Combustion Engine parts- Piston, Cylinder, Connecting rod, Crank shaft, Flywheel & valves | 7 | 20% |
| **END SEMESTER EXAM** | | | |

**QUESTION PAPER PATTERN**

Maximum Marks : 100 Exam Duration: 3 Hrs

**PART A**
3 Questions uniformly covering modules 1 and 2. Each question carries 15 marks. Students will have to answer any two questions out of four. (2X15=30 marks)

**PART B**
3 Questions uniformly covering modules 3 and 4. Each question carries 15 marks. Students will have to answer any two questions out of four. (2X15=30 marks)

**PART C**
3 Questions uniformly covering modules 5 and 6. Each question carries 20 marks. Students will have to answer any two questions out of four. (2X20=40 marks)

**Note:** Each question can have maximum of 4 sub questions, if needed.

| Course code | Course Name | L-T-P-Credits | Year of Introduction |
|---|---|---|---|
| ME332 | COMPUTER AIDED DESIGN AND ANALYSIS LAB | 0-0-3-1 | 2016 |

**Prerequisite: ME308 Computer aided design and analysis**

**Course Objectives:**

- To provide working knowledge on Computer Aided Design methods and procedures
- To impart training on solid modelling software
- To impart training on finite element analysis software

**Syllabus**

Introduction to solid modeling and Finite Element Analysis software.

Exercises on modeling and assembly.

a. Creation of higher end 3D solid models.(minimum 3 models)

b. Creation of assembled views of riveted joints, cotter joints and shaft couplings. (minimum 3 models)

Exercises on the application of Finite Element Method/Finite Volume Method to engineering systems:-

a. Structural analysis. (minimum 3 problems)

b. Thermal analysis. (minimum 2 problems)

c. Fluid flow analysis. (minimum 1 problem)

**Expected outcome:**

The students will be able to

i. Gain working knowledge in Computer Aided Design methods and procedures

ii. Solve simple structural, heat and fluid flow problems using standard software

**Points to note:**

- Any appropriate solid modeling software (like CATIA, Solids Works, ProE, IDEAS, Siemens Solid Edge and NX, free software, etc.) and package (like ANSYS, Comsol Multi Physics, NASTRAN, ABAQUS, ADINA, Siemens Femap Nastran,free software etc.) may be used.
- **Evaluation**

  Class exercises 60 marks
  Regular class viva 10 marks
  Final internal exam using software 30 marks
  All the above three evaluations are mandatory.

**References Books**:


1. Daryl Logan, A First course in Finite Element Method, Thomson Learning, 2007
2. David V Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill,2003
3. Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill, 2007
4. Mikell P. Groover and Emory W. Zimmer, CAD/ CAM – Computer aided design and manufacturing, Pearson Education,1987
5. T. R. Chandrupatla and A. D. Belagundu, Introduction to Finite Elements in Engineering, Pearson Education, 2012

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| ME333 | HEAT ENGINES LAB | 0-0-3-1 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To give hands on experience in tesing different properties of fuels & lubricants
- To perform characteristic tests on petrol and diesel engines.

**List of Exercises/Experiments :**

1. Determination of viscosity using Saybolt Viscometer.
2. Determination of viscosity using Redwood Viscometer.
3. Determination of Flash point and Fire point using Pensky Marten's Apparatus.
4. Fuel Injection Pump Testing and Calibration of Fuel Injection pump.
4. Performance Test on Multi cylinder Four Stroke Diesel Engine.
5. Performance Test on Multi cylinder Four Stroke Petrol Engine.
6. Retardation Test on Twin cylinder Four Stroke Diesel Engine.
7. Morse Test on Multi cylinder Four Stroke Petrol engine.
8. Heat Balance Test on Multi cylinder Four Stroke Diesel Engine.
9. Volumetric Efficiency Test on Multi cylinder Four Stroke Diesel Engine.
10. Volumetric Efficiency Test on Multi cylinder Four Stroke Petrol Engine.
11. Cooling curve Test on Twin cylinder Four stroke Diesel Engine.
12. Valve Timing on Four stroke Diesel/ Petrol Engine
13. Determination of calorific value of liquid fuel using bomb calorimeter
14. Determination of calorific value of gaseous fuel using Junker's calorimeter

**Note: Minimum 12 experiments are mandatory**

**Expected outcome**:

The students will be able to

i. Test different Properties of fuels and lubricants.
ii. Test petrol and diesel engines to evaluate their performance

**List of Equipments**

- Saybolt viscometer
- Redwood viscometer
- Pensky Marten's flash & fire point apparatus
- Fuel pump testing and calibrating machine
- Single/multicylinder engine (petrol/diesel) for valve timing
- Single/Twin cylinder 4 stroke diesel engine with rope drum/electrical dynamometer
- Multi cylinder petrol engine with eddycurrent/hydraulic dynamometer
- Multi cylinder diesel engine with eddycurrent/hydraulic dynamometer
- Bomb Calorimeter
- Junker's gas calorimeter

| Course code | Course Name | L-T-P - Credits | Year of Introduction |
|---|---|---|---|
| ME335 | PRODUCTION ENGINEERING LAB | 0-0-3-1 | 2016 |

**Prerequisite: Nil**

**Course Objectives**

- To give an idea about different manufacturing processes and to perform different types of tests on various works.

**List of Exercises/Experiments :**

Experiment on arc/TIG/MIG welding: -

1. butt welding and
2. lap welding

Experiment on lathe:-

3. Facing,
4. plain turning,
5. step turning,
6. parting – groove cutting,
7. knurling and chamfering
8. form turning and taper turning –
9. Eccentric turning.
10. Measurement of flank wear in turning process using tool makers microscope.

Experiment on thread cutting: -

11. single and multi start external
12. single and multi start internal threads,
13. Square and V-threads.

Experiment on drilling machine: -

14. Drilling,
15. boring,
16. reaming
17. counter sinking and taping

**Expected outcome**:

- The students will be able to perform welding and machining operations in lathe and drilling machine

**List of Equipments**

- 3 or 4 jaw Lathe
- Arc / TIG / MIG welding machine
- Drilling machine
- Thread cutting tools.