# Department of Automobile Engineering

# Academic Year 2018-19

# Seventh Semesters B.E

# Scheme and Syllabus

## Vision

To be a centre of excellence in the field of Automobile Engineering by providing quality education meeting the ever changing requirements of the industry.

## Mission

- To promote Research, Consultancy and Innovation leading to research publications & patents.
- To strengthen Industry Institute Interaction by collaborating with industries for training, internships, and industry expert talks.
- To inculcate Ethical, Social values and Environment awareness by participation in Co- curricular and Extra-curricular activities.

## Program Educational Objectives (PEO)

Graduates of BE program in Automobile Engineering will be able to

### PEO1
Engage in design of Automobile systems, tools and application in the field of Automobile Engineering and allied engineering industries.

### PEO2
Apply the knowledge of Automobile Engineering to solve the problems of social, environmental relevance and pursue higher Education and Research.

### PEO3
Work effectively as individuals and as team members in multi-disciplinary projects abiding professional practices.

### PEO4
Engage in life- long learning, career enhancement and adopt to change in professional and societal needs.

## MAPPING OF PEOs TO DEPARTMENT MISSION

| Program Educational Outcomes | M1(Research & Consultancy) | M2(Industry Institute Interaction) | M3(Ethics) |
|---|---|---|---|
| **PEO1:**Engage in design of Automobile systems, tools and application in the field of Automobile Engineering and allied engineering industries | 3 | 3 | 1 |
| **PEO2** Apply the knowledge of Automobile Engineering to solve the problems of social, environmental relevance and pursue higher Education and Research. | 3 | 1 | 3 |
| **PEO3** Work effectively as individuals and as team members in multi-disciplinary projects abiding professional practices. | 2 | 2 | 3 |
| **PEO4** Engage in life- long learning, career enhancement and adopt to change in professional and societal needs | 3 | 2 | 2 |

## PROGRAM OUTCOMES (POs)

| Graduate Attributes | PO# | Program Outcomes |
|---|---|---|
| Engineering knowledge | 01 | Apply the knowledge of mathematics, science, engineeringfundamentals, and engg. specialization to the solution of complex engineering problems |
| Problem analysis | 02 | Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences |
| Design / Development of Solutions | 03 | Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| Conduct Investigations of Complex Problems | 04 | Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions |
| Modern tool usage | 05 | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations, and servicing of automobiles. |
| The Engineer and society | 06 | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| Environment and sustainability | 07 | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development. |
| Ethics | 08 | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |

| Individual & team work | 09 | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
|---|---|---|
| Communication | 10 | Communicate effectively on complex engineering activities with the engineering community and with society at large. Some of them are, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| Project management and finance | 11 | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in Multidisciplinary environments. |
| Lifelong learning | 12 | Recognise the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change. |

## PROGRAM SPECIFIC OUTCOMES (PSOs)

After successful completion of Automobile Engineering Program, the graduates will be able to:

| PSO1 | Analyse, design and evaluate Automobile components and systems using conventional and/or CAD/ CAM tools. |
|---|---|
| PSO2 | Plan, process automation and quality assurance system for manufacturing of given Automobile components and systems. |

# NEW HORIZON COLLEGE OF ENGINEERING

## DEPARTMENT OF AUTOMOBILE ENGINEERING

### SCHEME OF SEVENTH SEMESTER

| Sl.No. | Course Code | Course | Subject Area | Credit Distribution | | | | Overall Credits | Contact Hrs Weekly Theory | Contact Hrs Weekly Lab | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | P | T | S | | | | CIE | SEE | Total |
| 1. | AUT71 | Earth Moving Equipments and Tractors+ Lab | PCC | 3 | 2 | 0 | 0 | 5 | 3 | 4 | 75 | 75 | 150 |
| 2. | AUT72 | Mechanical Vibration+ Lab | PCC | 3 | 2 | 0 | 0 | 5 | 3 | 4 | 75 | 75 | 150 |
| 3. | AUT73* | Professional Elective -III | PE | 3 | 0 | 0 | 1 | 4 | 4 | 0 | 50 | 50 | 100 |
| 4. | AUT74* | Professional Elective -IV | PE | 3 | 0 | 0 | 1 | 4 | 4 | 0 | 50 | 50 | 100 |
| 5. | NHOP** | Open Elective** | OE | 3 | 0 | 0 | 1 | 4 | 4 | 0 | 50 | 50 | 100 |
| 6. | AUT77 | Mini Project - 3 | PRJ | - | | | | 2 | - | - | 25 | 25 | 50 |
| **Total** | | | | 15 | 4 | 0 | 3 | 24 | 18 | 08 | 325 | 325 | 650 |

| Professional Elective - III (AUT73*) | |
|---|---|
| **Course** | **Course Name** |
| AUT731 | Operation Research |
| AUT732 | Industrial Automation and Robotics |
| AUT733 | Non Traditional Machining |
| AUT734 | Composite Materials |
| AUT735 | Computer Integrated Manufacturing |

| Professional Elective – IV (AUT74*) | |
|---|---|
| **Course** | **Course Name** |
| AUT741 | Rapid Prototyping |
| AUT742 | Control Engineering |
| AUT743 | Product Life Cycle Management |
| AUT744 | Autotronics |
| AUT745 | Automotive Aerodynamics |

# SEVENTH SEMESTER SYLLABUS

# EARTHMOVING EQUIPMENTS AND TRACTORS

**Course Code** :AUT71                                     **Credits**       :5
**L:P:T:S**       :3:2:0:0                       **CIE Marks**  :75
**Exam Hours**   :3                                    **SEE Marks**  :75

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT71.1 | Compare the different types ,construction and working of different earthmovers |
|---------|--------------------------------------------------------------------------------|
| AUT71.2 | Understand the undercarriage construction of earthmovers |
| AUT71.3 | Differentiate the suspension systems and transmission systems used in different earthmovers |
| AUT71.4 | Describe about the power steering and steering of tracked vehicles |
| AUT71.5 | Describe the different types of final drives and earth moving equipment management |
| AUT71.6 | Understand the hydraulic system of earthmovers and method of selection of earthmovers |

**Mapping of Course Outcomes to Program Outcomes:**

|         | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| AUT71.1 | 3 | 3 | 3 | - | - | 2 | 1 | 2 | 1 | 2 | - | 2 |
| AUT71.2 | 3 | 3 | 3 | - | 2 | 1 | 1 | 1 | 1 | 2 | - | 2 |
| AUT71.3 | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 2 |
| AUT71.4 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | 1 | 2 | - | 2 |
| AUT71.5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 |
| AUT71.6 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | 1 | 2 | 1 | 2 |

| Module No. | Module Contents | Hours | Cos |
|------------|-----------------|-------|-----|
|            |                 |       |     |

| 1 | **Different types of earth moving equipment and their applications.** Dozers, Loaders, Shovels, Excavators, Scrapers, Motor graders, Rollers, Compactors, Tractors and Attachments, Tyre and tracked vehicles , advantages and disadvantages, Under carriage components like, tracks, roller frames, drive sprockets, track rollers, track chains and track shoes.<br>**List of experiments**<br>1.Testing and servicing of electrical components, like battery, starting system, lighting system and alternator<br>2.Sparkplug cleaning | 9 | **AUT71.1, AUT71.2** |
|---|---|---|---|
| 2 | **Suspension**: rubber spring suspension and air suspension All systems of engine and special features like automatic timer, turbochargers, after coolers etc. **Basic types of transmissions**, auxiliary transmission, compound transmission, twin triple countershaft transmissions and planetary transmission, constructional and working principles, hydro shift automatic transmission and retarders.<br>**List of experiments**<br>1.Preparation of chart on trouble shooting manual transmission<br>2.Vaccum test of petrol and diesel engine | 9 | **AUT71.3** |
| 3. | **Power steering**- linkage type power steering, semi integral power steering & integral power steering.<br>**Steering Of Tracked Vehicles**: Skid steering, articulated steering, clutch /brake steering system, controlled differential steering system and planetary steering system.<br>**List of experiments**<br>1.Preparation of steering and suspension trouble-diagnosis chart<br>2. Preparation of rear wheel drive line trouble-diagnosis chart | 9 | **AUT71.4** |
| 4. | **Final Drives**: Types of reductions like, single reduction, double reduction final drives and planetary final drives, PTO shaft.<br>**Earth Moving Equipment Management**- Earth moving equipment maintenance- Type of maintenance schedules, purpose and advantages, organization set ups and documentation<br>**List of experiments**<br>1.FIP Calibration<br>2.Study of Cylinder Reboring | 9 | AUT71.5 |
| 5. | **Hydraulic systems**: Basic components of hydraulic systems like pumps (types of pumps), control valves like flow control valves, directional control valves and pressure control valves, hydraulic motors and hydraulic cylinders. Depth & draft control systems<br>**Method of selection of equipment**- selection of machine, basic rules of matching machine, selection of equipment including the nature of operation, selection based on type of soil, based on haul distance, based on weather condition.<br>**List of experiments**<br>1. Study of Valve Lapping & Valve Refacing<br>2. Study of Nozzle Regrinding | 9 | **AUT71.6** |

**Text Books:**

1. Diesel equipment- volume I and II by Erich J.schulz
2. Construction equipment and its management By S.C. Sharma

**REFERENCE BOOKS:**

1. Farm machinery and mechanism by Donald R. hunt and L. W.garner
2. Theory of ground vehicles by J.Y.Wong john Wiley and sons
3. Moving the earth by Herbert Nicholas
4. On and with the earth by Jag man Singh, W.Newman and Co. culkatta

**MOOCs:**

1. Working of turbocharger-https://www.youtube.com/watch?v=Kur5XTwmlGc
2. Power steering--https://www.youtube.com/watch?v=a2LSfEMTpMY

## Assessment Pattern:

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Co-Curricular |
|---|---|---|---|---|
| Marks ( out of 50) | 25 | 10 | 5 | 10 |
| Remember | 10 | | | 5 |
| Understand | 10 | 5 | 5 | |
| Apply | | 5 | | 5 |
| Analyse | | | | |
| Evaluate | 5 | | | |
| Create | | | | |

### CIE- Continuous Internal Evaluation for lab (25 Marks)

| Bloom's Category | Tests | Record | Viva |
|---|---|---|---|
| Marks ( out of 25) | 10 | 10 | 05 |
| Remember | 2 | | 1 |
| Understand | 2 | 10 | 1 |
| Apply | 2 | | 1 |
| Analyse | 2 | - | 1 |
| Evaluate | 2 | - | 1 |
| Create | - | | |

### SEE – Semester End Examination
### (50 Marks – Theory)

| Bloom's Category | SEE (Theory) |
|---|---|
| Remember | 10 |
| Understand | 20 |
| Apply | 10 |
| Analyse | |

| | |
|---|---|
| Evaluate | 10 |
| Create | |

**SEE – Semester End Examination**
**(25 Marks –Lab)**

| Bloom's Category | Tests |
|---|---|
| Remember | 3 |
| Understand | 8 |
| Apply | 3 |
| Analyse | 5 |
| Evaluate | 6 |
| Create | |

## MECHANICAL VIBRATIONS

| | | | |
|---|---|---|---|
| **Course Code** | :AUT72 | **Credits** | :05 |
| **L:P:T:S** | :3:2:0:0 | **CIE Marks** | :75 |
| **Exam Hours** | :03 | **SEE Marks** | :75 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| AUT72.1 | Calculate the natural frequency of the vibratory systems. |
| AUT72.2 | Analyze undamped, damped and forced vibratory systems. |
| AUT72.3 | Solve differential equations concerned to different vibratory systems |
| AUT72.4 | Identify vibration measuring techniques and also control of vibration. |
| AUT72.5 | Formulate mathematical equations for different types of vibrations for single and multi-degree freedom systems. |
| AUT72.6 | Analyse vibration problems using modern tools |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUT72.1** | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 |
| **AUT72.2** | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 |
| **AUT72.3** | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 |
| **AUT72.4** | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 |
| **AUT72.5** | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 |
| **AUT72.6** | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **Introduction**: Introduction to Vibrations <br> **Undamped free vibrations**: Single degree of freedom systems. Undamped free vibration-natural frequency of free vibration, stiffness of spring elements, effect of mass of spring. Beat phenomena. Simple Harmonic Motion. <br> **List of Experiments:** <br> Introduction to matLab, Programming, Matrices, Solution of Differential equations, Laplace transformation, Fourier series. | 08 | AUT72.1 |
| 2 | **Damped free vibrations**: Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement <br> **List of Experiments:** <br> Problems on Engineering mechanics Trusses, Numerical methods, Gauss-elimination method. | 09 | AUT72.2 |
| 3. | **Forced Vibration**: Single degree freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, Reciprocating and rotating unbalance, vibration isolation, transmissibility ratio -harmonic excitation and support motion. Whirling of shafts with and without damping. Discussion of speeds above and below critical speeds. | 09 | AUT72.3 |

| | | | |
|---|---|---|---|
| | **List of Experiments:**<br>Problems on Mechanical Vibration, SDOF, MDOF, Transmissibility. | | |
| 4. | **Systems with two degrees of freedom**: Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Forced Oscillations-Harmonic excitation.<br><br>**Vibration Measurement and Applications:** Transducers, Vibration Pickups, Frequency measuring Instruments, Vibration exciters, Signal Analysis, Experimental Analysis, Machine Condition Monitoring and Diagnosis. Signal analysis.<br><br>**List of Experiments:**<br>Case studies of Automobile engineering using Matlab/simulink | 09 | AUT72.4 |
| 5. | **Vibration Control:**<br>Vibration Nomograph and Vibration Criteria, Balancing of Rotating Machines, Whirling of Rotating shafts, Control of Natural Frequencies, Introduction to damping, Vibration Isolation, Vibration Absorbers.<br>**Numerical methods for Multi degree Freedom systems**: Introduction, Influence coefficients, Maxwell reciprocal theorem, Matrix Method, Matrix iteration-Method. Holzer and Stodola method,<br>**List of Experiments:**<br>Case studies of Automobile engineering using Matlab/simulink<br>CNC part programming on Turning and milling (Demonstration only) | 09 | AUT72.5 |

**Text Books:**

1. **Mechanical Vibrations** (English) 8th Edition, G. K. Grover, Nem Chand and Brothers
2. **Mechanical Vibrations**: V.P. Singh, DhanpatRai& Company Pvt. Ltd., 3rd edition, 2006.

**Reference Books:**

1. Mechanical Vibrations: S.S. Rao, Pearson Education Inc., 4th Edition, 2003.
2. Mechanical Vibrations: S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill,
   Special Indian edition, 2007
3. Theory & Practice of Mechanical vibrations: J.S. Rao& K. Gupta, New Age
4. MatLab An introduction with application: Rao V Dukkkipati, New Age International Publications.
5. Vehicle Noise, Vibration, and Sound Quality, Gang Sheng, SAE International, 2012.

**Assessment Pattern:**

**CIE- Continuous Internal Evaluation for theory (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Co-curricular |
|---|---|---|---|---|
| Marks ( out of 50) | 25 | 10 | 05 | 10 |
| Remember | 05 | | 03 | |
| Understand | 05 | | 02 | |
| Apply | 05 | 05 | | 10 |
| Analyze | 05 | 05 | | |
| Evaluate | 05 | | | |
| Create | | | | |

### CIE- Continuous Internal Evaluation for Lab(25 Marks)

| Bloom's Category | Tests | Record | Viva |
|---|---|---|---|
| Marks ( out of 50) | 10 | 10 | 05 |
| Remember | 02 | 02 | 02 |
| Understand | 02 | 02 | 02 |
| Apply | 02 | 02 | 01 |
| Analyze | 02 | 02 | |
| Evaluate | 02 | 02 | |
| Create | | | |

### SEE – Semester End Examination (50 Marks –Theory)

| Bloom's Category | SEE(Theory) |
|---|---|
| Remember | 10 |
| Understand | 10 |
| Apply | 15 |
| Analyze | 10 |
| Evaluate | 05 |
| Create | |

### SEE – Semester End

### Examination (25Marks – Lab)

| Bloom's Category | SEE (Lab) |
|---|---|
| Remember | 05 |
| Understand | 05 |
| Apply | 05 |
| Analyze | 05 |
| Evaluate | 03 |
| Create | 02 |

# OPERATIONS RESEARCH

**Course Code** : AUT731           **Credits** :04
**L:P:T:S** :3:0:0:1           **CIE Marks** :50
**Exam Hours** :03           **SEE Marks** :50

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| **AUT731.1** | Understand the scope of OR, and Solve Linear Programming Problems |
| **AUT731.2** | Solve the Transportation Problems, & Traveling Salesman Problems |
| **AUT731.3** | Do sequencing of "Number of jobs and machines" |
| **AUT731.4** | Formulate the Games and Finding the value of the game using Graphical and Dominance rule |
| **AUT731.5** | Analyse Queuing system and their characteristics and Steady state performance of M/M/ 1 and M/M/C queuing model. |
| **AUT731.6** | Construct the Network to Find the Critical Path, Duration for the Project and Prediction of date of completion |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUT731.1** | 3 | 3 | 3 | 2 | - | 2 | 2 | 2 | - | 1 | - | 1 |
| **AUT731.2** | 3 | 3 | 3 | 2 | - | 2 | 2 | 2 | - | 1 | - | 1 |
| **AUT731.3** | 3 | 3 | 3 | - | - | - | - | 2 | - | 1 | - | 1 |
| **AUT731.4** | 3 | 3 | 3 | - | - | - | - | 2 | - | 1 | - | 1 |
| **AUT731.5** | 3 | 3 | 3 | - | - | - | - | 2 | - | 1 | - | 1 |
| **AUT731.6** | 3 | 3 | 3 | - | - | - | - | 2 | - | 1 | 1 | 1 |

| Module No. | Module Contents | Hours | CO's |
|---|---|---|---|
| 1 | Introduction:<br>Linear programming, Definition, scope of Operations Research (O.R) approach and limitations of OR Models, Characteristics and phases of OR Mathematical formulation of L.P. Problems. Graphical solution<br>Linear Programming Problems:<br>The simplex method - slack, surplus and artificial variables. Concept of duality, two phase method, dual simplex method, degeneracy, and procedure for resolving degenerate cases. | 09 | AUT731.1 |
| 2 | Transportation Problem:<br>Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems.<br>Assignment Problem: Formulation, unbalanced assignment problem, traveling problem | 09 | AUT731.2 |
| 3. | Sequencing:<br>Johnson's algorithm, n - jobs to 2 machines, n jobs 3machines, n jobs n machines without passing sequence.<br>2 jobs n machines with passing. Graphical solutions | 09 | AUT731.3 |
| 4. | Game Theory:<br>Formulation of games, two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property.<br>Queuing Theory:<br>Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analyzing of M/M/ 1 and M/M/C queuing model. | 09 | AUT731.4, AUT731.5 |
| 5. | PERT-CPM Techniques:<br>Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks. | 09 | AUT731.6 |

*Self-Study: Case studies on Operation Research*

**Text Books:**
1.Taha H.  A. - Operations Research and Introduction, Macmillan edition
2. Operations Research: Principles and practice: Ravindran, Phillips & Solberg, Wiley India ltd, 2nd Edition 2007.

**REFERENCE BOOKS:**

1. AM Natarajan, P.Balasubramani ,ATamilaravari "Operation research" Pearson 2005
2. Hiller and Lieberman, Introduction to operation research. Mc Grew Hill. 5th edition 2001.
3. S. D. Sharma – Operations Research KedarnathRamnath& Co 2002.
4.Dr.Phaneesh, "Operations Research"SudhaPublictions, 5$^{th}$ edition, 2014
5. Prem Kumar Gupta "Operations Research" S Chand, 7$^{th}$ edition, 2014

**Assessment Pattern:**

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| Marks ( out of 50) | 25 | 10 | 10 | 10 |
| Remember | | | | |
| Understand | 5 | | 5 | |
| Apply | 5 | | | 5 |
| Analyze | 5 | 5 | 5 | 5 |
| Evaluate | 5 | | | |
| Create | 5 | 5 | | |

### SEE – Semester End Examination
### (50 Marks – Theory)

| Bloom's Category | Tests (Theory) |
|---|---|
| Remember | 10 |
| Understand | 10 |
| Apply | 10 |
| Analyze | 10 |
| Evaluate | 05 |
| Create | 05 |

## Industrial Automation and Robotics

**Course Code** : AUT732            **Credits** : 4
**L:P:T:S** : 3:0:0:1            **CIE Marks** : 50
**Exam Hours** : 3            **SEE Marks** : 50

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| AUT732.1 | Understand the automation principles and computer process control |
| AUT732.2 | Understand the components and principle of automated manufacturing sytems. |
| AUT732.3 | Explain automated inspection technology and their application. |
| AUT732.4 | Explain robot configuration and robot programming methods. |
| AUT732.5 | Explain various applications of robotics in automation. |
| AUT732.6 | Understand the recent developments in robotics and its application in automation |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT732.1 | 3 | 1 | - | 3 | - | - | - | 1 | 2 | 3 | 3 | 1 |
| AUT732.2 | 3 | 1 | - | 3 | - | - | - | 1 | 2 | 2 | 2 | 1 |
| AUT732.3 | 3 | 1 | - | 3 | - | - | - | 1 | 1 | 1 | 1 | 1 |
| AUT732.4 | 3 | 1 | - | 3 | - | - | - | 1 | 2 | 2 | 1 | 1 |
| AUT732.5 | 3 | 1 | - | 3 | - | - | - | 1 | 1 | 1 | 3 | 1 |
| AUT732.6 | 3 | 1 | - | 3 | - | - | - | 1 | 2 | 2 | 1 | 1 |

| Module No. | Module Contents | Hours | Co's |
|---|---|---|---|
| 1 | **Introduction:** Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies<br><br>**Industrial Control System:** Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control. | 9 | **AUT732.1** |
| 2 | **Automated Manufacturing Systems:** Components of Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells. | 9 | **AUT732.2** |

| | | | |
|---|---|---|---|
| 3. | **Inspection Technologies:** Automated Inspection, Coordinate Measuring Machines Construction, Operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Techniques & Non-contact Non-optical Inspection Technologies. | 9 | **AUT7323** |
| 4. | **Robotics:** Introduction, history of robots, robot anatomy, robot joints, robot configuration, robot specification and work volume, robot motion, robot control, robot drive, programming the robot. | 9 | **AUT732.4** |
| 5. | **Industrial Applications of Robots**: Application of robots - Material handling: Machine loading and unloading, Assembly, Inspection, Welding, Spray painting, Mobile robot, Microbots, Recent developments in robotics, safety considerations. | 9 | **AUT732.5 AUT732.6** |

**Self Study:** Recent developments in Robotics

**Text Books:**
1. Automation, Production System & Computer Integrated Manufacturing, M. P. Groover, Person India, 2015, 3rd Edition.
2. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India.

**Reference Books:**
1. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
2. Performance Modeling of Automated Manufacturing Systems, Viswanandham, PHI
3. Computer Based Industrial Control, Krishna Kant, EEE-PHI
4. Fundamentals of Robotics, Analysis and Control, Schilling R. J., PHI, 2006

**MOOCs:**
1. https://onlinecourses.nptel.ac.in/noc18_ee12/preview
2. http://nptel.ac.in/courses/112102011/

**Assessment Pattern:**

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| **Marks ( out of 50)** | **25** | **10** | **05** | **10** |
| Remember | 10 | | | |
| Understand | 10 | | 05 | |
| Apply | 05 | 05 | | 05 |
| Analyze | | 05 | | 05 |
| Evaluate | | | | |
| Create | | | | |

**SEE – Semester End Examination**
**(50 Marks – Theory)**

| Bloom's Category | Tests (Theory) |
| --- | --- |
| Remember | 20 |
| Understand | 20 |
| Apply | 10 |
| Analyze | |
| Evaluate | |
| Create | |

# Non Traditional Machining

**Course Code** : AUT733          **Credits** : 4
**L:P:T:S** : 3:0:0:1          **CIE Marks** : 50
**Exam Hours** : 3          **SEE Marks** : 50

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| AUT733.1 | Understand the need and appreciate the use of Non Traditional Machining methods, Differentiate between Traditional and Non Traditional Machining |
| AUT733.2 | Explain the principles, methodology and applications of Ultrasonic Machining |
| AUT733.3 | Explain the principles, methodology and applications of Abrasive Jet Machining |
| AUT733.4 | Understand the chemistry and metal removal process Electro-Chemical and Electrical machining. |
| AUT733.5 | Explain various parameters which govern the different techniques of analysing plasma, laser and electron beam machining |
| AUT733.6 | Evaluate the application of the different Non Traditional Machining techniques, and select an appropriate technique according to a specific requirement. |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT733.1 | 3 | 3 | - | 2 | - | - | - | 3 | 1 | 1 | - | 3 |
| AUT733.2 | 3 | 2 | - | 1 | 2 | 3 | - | 3 | 2 | 1 | 3 | 2 |
| AUT733.3 | 3 | 1 | - | 2 | 1 | 2 | - | 2 | 3 | 1 | 1 | 1 |
| AUT733.4 | 3 | 2 | - | 3 | 3 | 2 | - | 1 | 2 | 2 | 1 | 2 |
| AUT733.5 | 3 | 1 | - | 1 | 1 | 3 | - | 2 | 2 | 3 | 3 | 1 |
| AUT733.6 | 3 | 1 | - | 2 | 1 | 3 | - | 3 | 3 | 3 | 2 | 2 |

| Module No. | Module Contents | Hours | Co's |
|---|---|---|---|
| 1 | **Introduction:** History, Classification, comparison between conventional and Non-conventional machining process selection<br><br>**Ultra sonic machine(USM):** Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Effect of parameter: Effect of amplitude and frequency and vibration, Effect of grain diameter, effect of applied static load, effect of slurry, tool & work material, USM Process characteristics, Applications, Advantages and limitations. | 9 | **AUT733.1 AUT733.2 AUT733.6** |
| 2 | **Abrasive Jet Machining (AJM):** Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean No. abrasive particles per unit volume of the carrier gas, work material, stand off distance (SOD). Process characteristics, Applications, Advantages and limitations.<br><br>**Water Jet Machining**: Principal, Equipment, Operation, Applications, Advantages and limitations. | 9 | **AUT733.3 AUT733.6** |
| 3 | **Electrochemical machining (ECM):** Introduction, study of ECM machine, elements of ECM process: Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics, Applications, Advantages and limitations.<br><br>**Electrical discharge machining (EDM):** Introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, Process characteristics, Applications, Advantages and limitations. | 9 | **AUT733.4 AUT733.6** |
| 4 | **Plasma Arc Machining (PAM):** Introduction, equipment non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, Process characteristics. Safety precautions, Applications, Advantages and limitations. | 9 | **AUT733.5 AUT733.6** |
| 5 | **Laser Beam Machining (LBM):** Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages and limitations.<br><br>**Electron Beam Machining (EBM):** Principles, equipment, operations, Applications, Advantages and limitations. | 9 | **AUT733.5 AUT733.6** |

**Self Study:** Study of specific applications of NTM processes in automotive industry

**Text Books:**
1. Modern machining process, by PandeyAnd Shan, TATA McGraw Hill 2000.
2. New technology by Bhattacharaya, 2000.

**Reference Books:**
1. Production Technology, by HMT TATA McGraw Hill. 2001.
2. Modern Machining Process by Aditya. 2002.
3. Non-Conventional Machining, by P.K.Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House – 2005.
4. Metals Handbook: Machining, (Hardcover) volume 16, by Joseph R. Davis (Editor), American Society of Metals (ASM).

**MOOCs:**
1. http://nptel.ac.in/courses/112105126/36

**Assessment Pattern:**

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| Marks ( out of 50) | 25 | 10 | 05 | 10 |
| Remember | 10 | | | |
| Understand | 10 | | | |
| Apply | 05 | 05 | 05 | 05 |
| Analyze | | 05 | | 05 |
| Evaluate | | | | |
| Create | | | | |

### SEE – Semester End Examination
### (50 Marks – Theory)

| Bloom's Category | Tests (Theory) |
|---|---|
| Remember | 20 |
| Understand | 20 |
| Apply | 10 |
| Analyze | |
| Evaluate | |
| Create | |

# COMPOSITE MATERIALS

**Course Code: AUT734**                                              **Credits    : 04**
**L: P: T: S        : 3:0:0:1**                                       **CIE Marks: 50**
**Exam Hours   : 03**                                                **SEE Marks: 50**

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| AUT734.1 | Understand the basic concepts of composite materials. |
| AUT734.2 | Evaluate the structural and non-structural applications of composites. |
| AUT734.3 | Distinguish between properties and applications of different types of reinforcement and matrix. |
| AUT734.4 | Understand the fabrication techniques involved in the polymer, metal and ceramic matrix composites. |
| AUT734.5 | Apply the mechanics of composite materials. |
| AUT734.6 | Analyze the advances in the field of composite materials. |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | POI0 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT734.1 | 3 | 3 | 2 | - | - | - | - | - | - | 3 | - | 1 |
| AUT734.2 | 3 | 3 | 3 | 3 | 2 | 3 | - | - | - | 3 | 2 | 1 |
| AUT734.3 | 3 | 3 | 2 | 2 | - | - | - | 1 | - | - | - | 1 |
| AUT734.4 | 3 | | 1 | 2 | - | 3 | 2 | - | 3 | 3 | - | 1 |
| AUT734.5 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | 2 | 1 |
| AUT734.6 | 3 | | 2 | 2 | 2 | - | 2 | - | 3 | 3 | - | 1 |

| Module No | Module Contents | Hrs | COs |
|---|---|---|---|
| 1 | **Introduction to composite Materials**<br>Definition, classification of composite materials, classification based on matrix material, classification based on reinforcements: Laminar composites, particulate composites, advantages & limitations of composites<br>**Application of composites**<br>Automobile, aircrafts, missiles, space, electrical and electronics, marine, recreational and sports equipment, superconducting and magnetic applications. | 09 | AUT734.1, AUT734.2 |
| 2 | **Mechanics of composites**<br>Functions of reinforcement and matrix materials,Macromechanics: lamina assumptions, generalized Hooke's law. reduction to homogeneous orthotropic lamina , isotropic limit case, orthotropic stiffness matrix , rule of mixtures.<br>Micromechanics: volume and mass fractions, density and void content, longitudinal and transverse Young's modulii, Simple problems. | 09 | AUT734.5 |

| | | | |
|---|---|---|---|
| 3 | **Polymer matrix composites (PMC)**<br>Polymer matrix resins – Thermosetting resins, thermoplastic resins, Reinforcement fibres – rovings, woven fabrics, non woven random mats, layup and curing, fabricating process – open and closed mould process – hand layup , spray up process, bag molding, filament winding, pultrusion, pulforming, thermo – forming, injection moulding, resin transfer moulding (RTM), compression moulding. | 09 | AUT734.3, AUT734.4 |
| 4 | **Metal Matrix Composites (MMC) and Ceramic Marix Composites (CMC)**<br>Reinforcement materials, types, characteristics, need for MMC's and its application, fabrication process for MMC's: Powder metallurgy technique, diffusion bonding, liquid metallurgy technique, stir casting, squeeze casting, properties of MMCs.<br>Ceramic materials, properties, need for CMC, types of Ceramic Matrix composites-: Oxide ceramics, non oxide ceramics, aluminium oxide, silicon nitride, processing of CMCs: sintering, hot pressing, cold isostaticpressing, hot isostatic pressing. | 09 | AUT734.3, AUT734.4 |
| 5 | **Advances in composite materials**<br>Joining of composites: adhesively bonded joints & mechanically fastened joints<br>Carbon /carbon composites, advantages and limitations of carbon matrix, carbon fibre - chemical vapour deposition of carbon on carbon fibre preform. Sol gel technique, shape memory alloys.<br>Environmental Effects of composites, recycling of composites | 09 | AUT734.6 |

**Self study:**

1. Case study on design and fabrication of an automobile composite structure.

<div align="center">Or</div>

2. Fabrication of MMCs and PMCs.

**TEXT BOOKS:**

1. Krishan K. Chawla, *"Composite materials"*, Springer, 2012
2. Composite Science and Engineering by K.K.Chawla Springer Verlag
3. Mechanics of composites by Autar Kaw, CRC Press. 2005.

**REFERENCE BOOKS:**

1. Issac M. Daniel and OriIshai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition – 2007
2. Mallick, P.K., Fiber –"Reinforced Composites: Materials, Manufacturing and Design",Maneel
3. Brent Strong A, Fundamentals of Composite Manufacturing", Society of Manufacturing Engineers, 2008.
4. Robert M. Jones, "Mechanics of Composite Materials", McGraw Hill  Kogakusha Ltd.
5. Composite Materials by S.C. Sharma Narosa publishing house, New Delhi 2000

**E-Books:**

1. http://www.ae.iitkgp.ernet.in/ebooks/

**MOOCs:**

1. http://nptel.ac.in/downloads/101104010/

**CIE- Continuous Internal Evaluation (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self -Study |
|---|---|---|---|---|
| Marks (out of 50) | 25 | 10 | 05 | 10 |
| Remember | 05 | | | |
| Understand | 05 | | | |
| Apply | 05 | 05 | 05 | 05 |
| Analyze | 05 | 05 | | 05 |
| Evaluate | 05 | | | |
| Create | | | | |

**SEE – Semester End Examination (50 Marks)**

| Bloom's Category | Tests |
|---|---|
| Remember | 10 |
| Understand | 15 |
| Apply | 10 |
| Analyze | 10 |
| Evaluate | 5 |
| Create | |

**COMPUTER INTEGRATED MANUFACTURING**     Course Code   : AUT735
                                                                        Credits     : 04

L: P: T: S        : 3: 0: 0: 1                                    CIE Marks: 50
Exam Hours    : 03                                               SEE Marks: 50

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| **AUT735.1** | Understand the concept of production system, automation, mathematical models in production,  work part transfer mechanisms etc |
| **AUT735.2** | Analyze the Flow lines and solve problems on line balancing for various manufacturing systems. |
| **AUT735.3** | Understand the concept of Group Technology and Flexible Manufacturing System, its implementation and applications in industries. |
| **AUT735.4** | Apply the concepts, principles and recommendations for Design and development of automated assembly systems and Automated Guided Vehicles. |
| **AUT735.5** | Understand the concept of Computerized  Manufacturing planning systems |
| **AUT735.6** | Create the part programs for CNC Milling, Turning and drilling operations. |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUT735.1** | 3 | - | 2 | 3 | 3 | - | 1 | - | 3 | - | 3 | - |
| **AUT735.2** | 3 | 3 | - | 3 | 3 | - | - | 3 | - | 2 | - | - |
| **AUT735.3** | 3 | - | - | - | 3 | 1 | - | 3 | - | - | 3 | 2 |
| **AUT735.4** | 3 | 3 | 2 | 3 | 3 | - | - | - | 3 | - | 3 | - |
| **AUT735.5** | 3 | - | - | 3 | 3 | - | - | 3 | 3 | - | 3 | 2 |
| **AUT735.6** | 3 | 3 | - | 3 | 3 | - | - | - | - | 2 | - | - |

| Module No. | Module Contents | Hours | Co's |
|---|---|---|---|
| 1 | **Computer Integrated Manufacturing Systems :** Introduction, Automation definition, Types of automation, CIM, processing in manufacturing, Production concepts, Mathematical Models-Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, Work-in-process, WIP ratio, TIP ratio, Problems using mathematical model equations. | 9 | AUT735.1 |
| 2 | **High Volume Production System:** Introduction Automated flow line-symbols, objectives, Work part transport-continuous, Intermittent, synchronous, Pallet fixtures, Transfer Mechanism-Linear-Walking beam, roller chain drive, Rotary-rack and pinion, Rachet& Pawl, Geneva wheel, Buffer storage, Control functions. Automation for machining operation **Analysis of Automated Flow line & Line Balancing :** General terminology and analysis, Analysis of Transfer Line with Out storage-upper bound approach, lower bound approach and problems, Analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with example problem, Partial automation-with numerical problem example, Manual Assembly lines line balancing problem | 9 | AUT735.1, AUT735.2 |
| 3. | **Group Technology and Flexible Manufacturing System:** Part families, Part classification and coding, Production Flow Analysis, Cellular manufacturing, Flexible Manufacturing Systems (FMS), FMS components, FMS applications and benefits, FMS planning and Implementation issues. **CNC Machining Centers:** Introduction to CNC, elements of CNC, CNC machining centers, part programming, and fundamental steps involved in development of part programming for milling and turning. | 9 | AUT735.3, AUT735.6 |
| 4. | **Automated Assembly Systems:** Design for automated assembly systems, types of automated assembly system, Parts feeding devices elements of parts delivery system-hopper, part feeder, Selectors, feedback, escapement and placement analysis of Multi station Assembly system and numericals. **Automated Guided Vehicle System:** Introduction, Vehicle guidance and routing, System management, Quantitative analysis of AGV's with numerical problems and application. | 9 | AUT735.4 |
| 5. | **Computerized Manufacturing Planning system :** Introduction, Computer Aided process planning, Retrieval types of process planning , Generative type of process planning, Material requirement planning, Fundamental concepts of MRP inputs to MRP, Capacity planning | 9 | AUT735.5 |

**Self study:**

Case study on implementation of CIM in industry.

**Text Books:**

1. Automation, Production System & Computer Integrated Manufacturing, M. P. Groover, Person India, 2015, 3$^{rd}$ Edition.
2. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India.

**Reference books:**

1. Computer Integrated Manufacturing, J. A. Rehg& Henry. W.Kraebber.
2. CAD/CAM by Zeid, Tata McGraw Hill.

**MOOCs:**

1. https://onlinecourses.nptel.ac.in/noc18_ee12/preview
2. http://nptel.ac.in/courses/112102011/
3. http://nptel.ac.in/courses/112103174/

**Assessment Pattern:**

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self -Study |
|---|---|---|---|---|
| Marks (out of 50) | 25 | 10 | 05 | 10 |
| Remember | 05 | | | |
| Understand | 05 | | 05 | |
| Apply | 05 | 05 | | |
| Analyze | 05 | 05 | | 05 |
| Evaluate | 05 | | | 05 |
| Create | - | | | |

### SEE – Semester End Examination (50Marks – Theory)

| Bloom's Category | Tests |
|---|---|
| Remember | 10 |
| Understand | 10 |
| Apply | 10 |
| Analyze | 10 |
| Evaluate | 5 |
| Create | 5 |

# Rapid Prototyping

**Course Code** : AUT741                                      **Credits** : 04
**L: P: T: S** : 3: 0: 0: 1                                   **CIE Marks: 50**
**Exam Hours** : 03                                           **SEE Marks: 50**

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT741.1 | Understand the basic concepts in rapid prototyping and its applications. |
|---|---|
| AUT741.2 | Apply the concepts of stereo lithography, selective laser sintering, fused deposition modeling etc. |
| AUT741.3 | Use different concept modelers and rapid prototyping software. |
| AUT741.4 | Distinguish different types of tooling for rapid prototyping. |
| AUT741.5 | Understand the factors influencing rapid manufacturing. |
| AUT741.6 | Identify various materials for rapid prototyping systems. |

**Mapping of Course Outcomes to Program Outcomes:**

|          | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| AUT741.1 | 3   | -   | -   | -   | 1   | 2   | 2   | 1   | -   | 3    | 2    | 3    |
| AUT741.2 | 3   | -   | 1   | -   | 1   | 3   | -   | -   | 3   | 3    | -    | -    |
| AUT741.3 | 3   | 3   | 2   | -   | 1   | -   | -   | -   | -   | 3    | -    | 3    |
| AUT741.4 | 3   | 3   | 3   | 2   | 1   | 2   | -   | -   | 3   | -    | -    | 3    |
| AUT741.5 | 3   | 3   | 1   | 2   | 1   | 3   | -   | -   | -   | -    | 2    | -    |
| AUT741.6 | 3   | -   | 3   | -   | 1   | -   | 2   | -   | -   | 3    | -    | 3    |

| Module No. | Module Contents | Hours | Co's |
|---|---|---|---|
| 1 | **Introduction:** Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.<br>**Stereo Lithography Systems**: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. | 9 | AUT741.1, AUT741.2 |
| 2 | **Selective Laser Sintering:** Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications.<br>**Fused Deposition Modelling**: Principle, Process parameter, Path generation, applications.<br>**Solid Ground Curing:** Principle of operation, Machine details, applications.<br>**Laminated Object Manufacturing**: Principle of operation, LOM materials. process details, application. | 9 | AUT741.2 |
| 3. | **Concepts Modelers:** Principle, Thermal jet printer, Sander's model market, 3-D printer. GenisysXs printer HP system 5, object Quadra systems<br>**Software For RP:** STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools. | 9 | AUT741.3 |
| 4. | **Rapid Tooling:** Indirect Rapid tooling, Silicon rubber tooling, Aluminium filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, etc.<br>Direct Rapid Tooling Direct. AIM.<br>Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling. | 9 | AUT741.4 |
| 5. | **Rapid Manufacturing Process Optimization:** Factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation.<br>**Materials For Rapid Prototyping Systems:** Type of material – polymers, metals, ceramics and composites, liquid based materials, photo polymer development – solid based materials, powder based materials. | 9 | AUT741.5, AUT741.6 |

**Self study:**

3D printing of automotive components.

**Text Books:**

1. Stereo Lithography and other RP & M Technologies, Paul F. Jacobs: SME, NY 1996.

2. Rapid Manufacturing, Flham D.T &Dinjoy S.S Verlog London 2001.

3. Rapid Prototyping, Principles and Applications, Rafiq I. Noorani ,Wiley& Sons, 2006.

**Reference Books:**

1. Rapid Prototyping, Terry Wohlers Wohler's Report 2000" Wohler's Association 2000.

2. N.Hopkinson, R.J.M, Hauge, P M, Dickens, "Rapid Manufacturing – An Industrial revolution for the digital age", Wiley, 2006

3. Chua C.K, Leong K.F and Lim C.S, "Rapid Prototyping: Principles and Applications", Second Edition, World Scientific, 2003.

**MOOCs:**
1. http://nptel.ac.in/courses/112102103/16
2. http://nptel.ac.in/courses/112107217/19
3. http://nptel.ac.in/courses/112107217/20

**Assessment Pattern:**
**CIE- Continuous Internal Evaluation (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self -Study |
|---|---|---|---|---|
| Marks (out of 50) | 25 | 10 | 05 | 10 |
| Remember | 05 | | | |
| Understand | 05 | | | |
| Apply | 05 | | 05 | |
| Analyze | 05 | 05 | | 05 |
| Evaluate | 05 | 05 | | 05 |
| Create | | | | |

**SEE – Semester End Examination (50 Marks)**

| Bloom's Category | Tests |
|---|---|
| Remember | 10 |
| Understand | 15 |
| Apply | 10 |
| Analyze | 10 |
| Evaluate | 5 |
| Create | |

# CONTROL ENGINEERING

| | | | |
|---|---|---|---|
| Course Code :AUT742 | | Credits :04 |
| L:P:T:S :3:0:0:1 | | CIE Marks :50 |
| Exam Hours :03 | | SEE Marks :50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| AU742.1 | Identify the components of control systems given real life situation |
|---|---|
| AU742.2 | Estimate the response characteristics and parameters related to stability of systems. |
| AU742.3 | Develop transfer function models and state-space models of single input single output, linear time invariant systems |
| AU742.4 | Analyse the time response of first and second order systems |
| AU742.5 | Evaluate the stability of systems using various methods |
| AU742.6 | Design PID controllers |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AU742.1 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| AU742.2 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| AU742.3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| AU742.4 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| AU742.5 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| AU742.6 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **INTRODUCTION TO CONTROL SYSTEMS & SYSTEM MODELLING**: Introduction, Basic Terminologies, Advantages of Control Systems, Open loop & Closed loop control systems, Real time applications, Analysis and design objectives, Properties of Feedback. Transfer Functions, models of mechanical systems (translational and rotational), Electrical Systems, Models of DC Motors, Block representation of control system elements, Modeling of mechanical & electrical systems in State Space. | 09 | AU742.1 |
| 2 | **TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS**: Types of standard test signals (inputs), poles and zeros. Analysis of first & second order system response to step input, pole-placement. Higher order system response, system response with zeros. Concept of stability: Rout-Hurwitz Criterion. Steady state errors, system type, static error constant. | 09 | AU742.2 |
| 3. | **ANALYSIS AND DESIGN USING ROOT LOCUS**: Definition of root loci, general rules for constructing root loci, Analysis using root locus | 09 | AU742.3 |
| 4. | **FREQUENCY RESPONSE ANALYSIS:**Nyquist criterion, Sketching Nyquist Diagram, Stability, Gain Margin & Phase Margin via Nyquist plots. Sketching of Polar Plots. | 09 | AU742.4 |

| 5. | **BODE PLOTS**: Introduction, Asymptotic Approximations: Bode Magnitude and Phase angle plots. Stability, Gain Margin & Phase Margin via Bode plot | **09** | **AU742.5** |
|---|---|---|---|

**SELF-STUDY:**

*Study the stability of control system using modern tools.*

**Text Books:**

1. Control Systems Engineering, 5th Edition, Norman S Nise, Wiley India -2009.

**Reference Books:**

1. **Modern Control Engineering**, Katsuhiko Ogata, Pearson Education, 2004
2. Automatic Control Systems, B.C.Kuo, F.Golnaraghi, John Wiley & Sons, 2003.
3. Modern Control Systems, Richard C Dorf& Robert H Bishop, Prentice Hall, 2008

E-Books:
1. Feedback Systems: An Introduction for Scientists & Engineers, Karl J Astrom& Richard M Murray, Version v2.10b, Princeton University Press -
http://www.cds.caltech.edu/~murray/books/AM05/pdf/am08-complete_22Feb09.pdf

**MOOCs:**

2. https://www.mooc-list.com/course/16101x-introduction-aerodynamics-edx
3. https://www.mooc-list.com/course/mae6226-aerodynamics-hydrodynamics-gw-online

**Assessment Pattern:**

**CIE- Continuous Internal Evaluation for theory (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| **Marks ( out of 50)** | **25** | **10** | **05** | **10** |
| Remember | 05 | | 03 | |
| Understand | 05 | | 02 | |
| Apply | 05 | 05 | | |
| Analyze | 05 | 05 | | 10 |
| Evaluate | 05 | | | |
| Create | | | | |

**SEE – Semester End Examination**
**(50 Marks – Theory)**

| Bloom's Category | SEE(Theory) |
|---|---|
| Remember | 10 |
| Understand | 10 |
| Apply | 15 |
| Analyze | 10 |
| Evaluate | 05 |
| Create | |

# PRODUCT LIFE CYCLE MANAGEMENT

| | | | |
|---|---|---|---|
| **Course Code** | : AUT743 | **Credits** | : 04 |
| **L:P:T:S** | : 3:0:0:1 | **CIE Marks** | : 50 |
| **Exam Hours** | : 03 | **SEE Marks** | : 50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| AUT743.1 | Analyse the various stages of PLM into engineering product ranges and portfolios that will evaluate into commercial success. |
| AUT743.2 | Evaluate data and information and/or communicate information to the supply chain and valuable supplier chain quotation to ensure sustainable solution. |
| AUT743.3 | Apply life cycle management strategies and knowledge to develop new and/or formulate appropriate engineering design solutions in engineering environment |
| AUT743.4 | Understand the legal, environmental and international regulatory frame works into product design, development and manufacturing requirements. |
| AUT743.5 | Develop the system for corrective and preventive action to track production quality issues. |
| AUT743.6 | Understand the preventive approaches concentrating on minimizing waste, hazard and risk associated with product design, development, manufacturing. |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT743.1 | 3 | 3 | - | - | - | - | - | 3 | - | 3 | - | 2 |
| AUT743.2 | 3 | 3 | 2 | - | 3 | - | - | 3 | 2 | 2 | - | 2 |
| AUT743.3 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | 2 | 2 | 2 |
| AUT743.4 | 3 | - | - | - | - | 2 | 2 | - | - | 1 | 2 | 2 |
| AUT743.5 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | - | 2 | - | 2 |
| AUT743.6 | 3 | 3 | - | - | - | - | - | 3 | 2 | 3 | - | 2 |

**SELF-STUDY:**

*Case study regarding Automobile accessories and Automobile components and its reusable values.*

| Module No. | Module Contents | Hours | Co's |
|---|---|---|---|
| 1 | **Introduction to Product Life Cycle Management(PLM):** Definition, PLM Lifecycle Model, Threads of PLM, Need for PLM,Opportunities and Benefits of PLM, Views, Components and Phases ofPLM, PLM feasibility Study, PLM Visioning. | 9 | AUT743.1 |
| 2 | **PLM Concepts, Processes and Workflow:** Characteristics of PLM, Environment Driving PLM, PLM Elements,Drivers of PLM, Conceptualization, Design, Development, Validation,Production, Support of PLM. | 9 | AUT743.1, AUT743.2 |
| 3. | **Collaborative Product Development:** Engineering Vaulting, Product Reuse, Smart Parts, Engineering Change Management, Bill of Materials and Process Consistency, Digital Mock-Up and Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral. | 9 | AUT743.2, AUT743.3 |
| 4. | **Digital Manufacturing – PLM:** Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning. | 9 | AUT743.4, AUT743.5 |
| 5. | **Developing a PLM Strategy and Conducting a PLM Assessment:** Strategy, Impact of strategy, Implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment, Assessment of Current Systems and Applications. | 9 | AUT743.5, AUT743.6 |

**Text Books:**

1. **Product Lifecycle Management :** Grieves, Michael, McGraw-Hil, Edition 2006.ISBN 0071452303
2. **PDM : Product Data Management :** Burden, Rodger, Resource Pub, 2003. ISBN 0970035225.

**Suggested Software Packages :**Catia V5R19, Delmia V5R19, 3D via Composer, 3DXML player, Smarteam V5R19

**REFERENCE BOOKS:**

1. Fabio Guidice, Guido La Rosa, **Product Design for the environment -A life cycle approach**, Taylor and Francis 2006.

2. Robert J. Thomas, "NDP: "**Managing and forecasting for strategic processes**".

3. Hartman, **"Product life cycle management with SAP"**, 2006

4. Stark, John, **"Product Life cycle Management: Paradigm for 21st Century Product Realization**", Springer-Verlag, 2004. ISBN 1852338105

5. Saaksvuori, Antti and Immpnen, Anselmi. **"Product Lifecycle Management**", Springer-Verlag, 2004. ISBN 3540403736

**MOOCs:**
1.https://onlinecourses.nptel.ac.in/noc18_me31/preview
2. https://www.youtube.com/watch?v=5OQAD606Yow
3. https://www.youtube.com/watch?v=gPQ92ma6KrI

**Assessment Pattern:**

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self study |
|---|---|---|---|---|
| **Marks ( out of 50)** | **25** | **10** | **05** | **10** |
| Remember | 10 | | | |
| Understand | 05 | 05 | | 05 |
| Apply | 05 | 05 | 05 | 05 |
| Analyze | 05 | | | |
| Evaluate | | | | |
| Create | | | | |

### SEE – Semester End Examination
### (50 Marks – Theory)

| Bloom's Category | Tests (Theory) |
|---|---|
| Remember | 20 |
| Understand | 15 |
| Apply | 05 |
| Analyze | 05 |
| Evaluate | 05 |
| Create | |

# Autotronics

| | | | |
|---|---|---|---|
| Course Code | : AUT744 | Credits | : 4 |
| L:P:T:S | : 3:0:0:1 | CIE Marks | : 50 |
| Exam Hours | : 3 | SEE Marks | : 50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT744.1 | Understand the principle and application of various automotive sensors. |
|---|---|
| AUT744.2 | Explain the principle and working of automotive safety systems. |
| AUT744.3 | Explain the principle and working of automotive comfort systems. |
| AUT744.4 | Explain the principle and working of automotive security systems. |
| AUT744.5 | Explain the principle and working of automotive instrumentation systems. |
| AUT744.6 | Apply the mechatronic approach for various specific automotive applications. |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT744.1 | 3 | 3 | 3 | 2 | 2 | 2 | - | 1 | 3 | 2 | 3 | 1 |
| AUT744.2 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 1 |
| AUT744.3 | 3 | 3 | 2 | 1 | 1 | 2 | - | 1 | 1 | 2 | 2 | 3 |
| AUT744.4 | 3 | 3 | 1 | 2 | 2 | 2 | - | 1 | 2 | 2 | 1 | 2 |
| AUT744.5 | 3 | 3 | 2 | 2 | 2 | 1 | - | 1 | 1 | 2 | 2 | 1 |
| AUT744.6 | 3 | 3 | 1 | 1 | 1 | 2 | - | 1 | 2 | 2 | 1 | 3 |

| Module No. | Module Contents | Hours | Co's |
|---|---|---|---|
| 1 | **Sensors And Actuators:** Mass air flow (MAF), exhaust gas oxygen, throttle plate angular position, crankshaft angular position/rpm, coolant temperature, intake air temperature, manifold absolute pressure (MAP), differential exhaust gas pressure, vehicle speed, pickups sensors, exhaust gas recirculation sensors, knock sensor, electric fuel pump motor characteristics, piezoelectric stack injectors and solenoids for injection systems. | 9 | **AUT744.1 AUT744.6** |
| 2 | **Safety Systems:** Active and passive safety, airbags, seat belt tightening system, forward collision warning systems, child lock, anti lock braking systems, electronic brakeforce distribution electronic stability control, , traction control system and lane departure warning system, low tire pressure warning system | 9 | **AUT744.2 AUT744.6** |
| 3 | **Comfort Systems:** Adaptive cruise control system, active suspension system, power steering, collapsible and tiltable steering column and power windows, Adaptive lighting system | 9 | **AUT744.3 AUT744.6** |
| 4 | **Security Systems:**Anti theft technologies – mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, smart card | 9 | **AUT744.4 AUT744.6** |

| 5 | **Instrumentation system**: Input and output signal conversion, multiplexing, fuel quantity measurement, coolant temperature and oil pressure measurement, display devices- LED, LCD, VFD and CRT, Onboard diagnostics, Off board diagnostics | 9 | **AUT744.5** **AUT744.6** |
|---|---|---|---|

**Self Study:** Study of autotronic systems used in F1 cars

**Text Books:**

1. William B Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Newne Butterworth-Heinermann, 7th edition 2012.
2. Tom Denton, " Autmobile Electrical and Electronic Systems", SAE publication, 2000.

**Reference Books:**

1. Robert Bosch "Automotive Hand Book", SAE (8th Edition), 2011.
2. Barry Hollembeak, "Automotive Electricity and Electronics", Delmar Cengage Learning; 5th edition, 2011
3. Robert Bosch, "Automotive Hand Book", SAE, 2000.
4. Bechhold, "Understanding Automotive Electronics", SAE, 1998.
5. Allan W M B, "Automotive Computer Controlled Systems", Elsevier Butterworth-Heinemann, 2011.

**Assessment Pattern:**

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| **Marks ( out of 50)** | **25** | **10** | **05** | **10** |
| Remember | 05 | | | |
| Understand | 15 | | 05 | |
| Apply | 05 | 05 | | 05 |
| Analyze | | 05 | | 05 |
| Evaluate | | | | |
| Create | | | | |

### SEE – Semester End Examination
### (50 Marks – Theory)

| Bloom's Category | Tests (Theory) |
|---|---|
| Remember | 10 |
| Understand | 30 |
| Apply | 10 |
| Analyze | |
| Evaluate | |
| Create | |

# AUTOMOTIVE AERODYNAMICS

| | | | |
|---|---|---|---|
| Course Code | :AUT745 | Credits | :04 |
| L:P:T:S | :3:0:0:1 | CIE Marks | :50 |
| Exam Hours | :03 | SEE Marks | :50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT745.1 | Understand the flow phenomenon of fluid over vehicles |
|---|---|
| AUT745.2 | Explain the various drag forces in an automobile |
| AUT745.3 | Discuss the shape optimization of cars |
| AUT745.4 | Explain the origin of forces and moments acting on the vehicle |
| AUT745.5 | Analyze the characteristics of forces and moments acting on a vehicle |
| AUT745.6 | Describe the wind tunnels used for testing of automobiles |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT745.1 | 3 | - | 1 | - | 3 | 3 | 3 | - | 1 | 1 | - | 1 |
| AUT745.2 | 3 | - | 1 | - | 3 | 1 | 3 | - | 1 | 1 | - | 1 |
| AUT745.3 | 3 | 3 | 1 | - | 3 | 2 | 2 | 2 | 1 | 1 | - | 1 |
| AUT745.4 | 3 | 3 | - | - | - | 2 | 1 | - | - | 1 | - | 1 |
| AUT745.5 | 3 | 3 | 1 | - | 2 | 1 | 2 | - | 1 | 3 | - | 1 |
| AUT745.6 | 3 | 3 | - | - | 2 | 1 | 1 | 2 | - | 3 | - | 1 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **Introduction:** Scope, historical development trends, Fundamental of fluid mechanics, Flow phenomenon related to vehicles, External & Internal flow problem, Resistance to vehicle motion, Fuel consumption and performance, Potential of vehicle aerodynamics. | 09 | AUT745.1 |
| 2 | **Aerodynamic Drag Of Cars:** Cars as a bluff body, Flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles. | 09 | AUT745.2 |
| 3. | **Shape Optimization Of Cars:** Front end modification, front and rear wind shield angle, Boat tailing, Hatch back, fast back and square back, Dust flow patterns at the rear, Effects of gap configuration, effect of fasteners. | 09 | AUT745.3 |
| 4. | **Vehicle Handling:** The origin of forces and moments on a vehicle, side wind problems, vehicle dynamics Under side winds, the effects of forces and moments, Characteristics of forces and moments, wind noise, drag reduction in commercial vehicles. | 09 | AUT745.4 AUT745.5 |
| 5. | **Wind Tunnels For Automotive Aerodynamic:** Introduction, Principle of wind tunnel technology, Limitation of simulation, Stress with scale models, full scale wind tunnels, measurement techniques, road testing methods, | 09 | AUT745.5 |

***Self-Study: Students are required to prepare a prototype of the various types of vehicles for analyzing the aerodynamics.***

**Text Books:**

1. Wolf-Heinrich Hucho, *"Aerodynamics of road vehicles",* 4th edition, 2000 **ISBN: 9781483102078**
2. Pope. A. "*Wind Tunnel Testing* ", John Wiley & Sons, 4th Edition New York, 2015, **ISBN: 9780470502075**

**Reference Books:**

1. Scibor-Rylski A.J, "*Road Vehicle Aerodynamics*", Pentech press, London 2nd Edition 1984, **ISBN: 9780471964186**
2. Automotive Aerodynamic: Update SP-706, SAE, 1987
3. Controlling Noise and Vibration in Road Vehicles, SAE
4. Vehicle Aerodynamics- SP-1145-SAE-1996
5. Hand book on vehicle body design – SAE publication

**MOOCs:**

1. https://www.mooc-list.com/course/16101x-introduction-aerodynamics-edx
2. https://www.mooc-list.com/course/mae6226-aerodynamics-hydrodynamics-gw-online

**Assessment Pattern:**

**CIE- Continuous Internal Evaluation for theory (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| **Marks ( out of 50)** | **25** | **10** | **05** | **10** |
| Remember | 05 | | 03 | |
| Understand | 05 | 05 | 02 | |
| Apply | 05 | 05 | | |
| Analyze | 05 | | | 10 |
| Evaluate | 05 | | | |
| Create | | | | |

**SEE – Semester End Examination**
**(50 Marks – Theory)**

| Bloom's Category | SEE(Theory) |
|---|---|
| Remember | 10 |
| Understand | 10 |
| Apply | 15 |
| Analyze | 10 |
| Evaluate | 05 |
| Create | |

# Syllabus for Open Electives

## Big Data Analytics Using HP Vertica- 1

Code : NHOP01                                    Credits: 04

L:P:T:S : 3:0:0:1                                CIE Marks: 50

Exam Hours : 3                                   SEE Marks: 50

**Course Outcomes: At the end of the Course, the Student will be able to:**

| CO1 | Demonstrate SQL command in Oracle and Vertica Databases |
|-----|--------------------------------------------------------|
| CO2 | Apply the features of Vertica in running database designer. |
| CO3 | Creation of projection , partition of table manually in Vertica |
| CO4 | Apply Copy, Delete, Merge, Purge concepts in Vertica database. |
| CO5 | Apply the concepts of HDFS in designing multi node clustering in Hadoop |
| CO6 | Demonstrate Hadoop ecosystem tools like Pig, HBase. |

**Mapping of Course Outcomes to Program Outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3 | 3 | 3 | 2 | 3 | 1 | - | - | 2 | - | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 1 | - | - | 2 | - | 2 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 1 | - | - | 2 | - | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 1 | - | - | 2 | - | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 1 | - | - | 2 | - | 2 | 2 |
| CO6 | 3 | 3 | 3 | 2 | 3 | 1 | - | - | 2 | - | 2 | 2 |

**Mapping of Course Outcomes to Program Specific Outcomes (PSOs):**

|     | PSO1 | PSO2 |
|-----|------|------|
| CO1 | 3 | 3 |
| CO2 | 3 | 3 |
| CO3 | 3 | 3 |
| CO4 | 3 | 3 |
| CO5 | 3 | 3 |
| CO6 | 3 | 3 |

| Module No. | Module Contents | Hours | COS |
|---|---|---|---|
| 1 | **Introduction to SQL and HP Vertica:**<br>Types of SQL, Data Types, Constrains, JOINS, Types of JOINS, Clause, Group by, Having, Order by, Where Clause with examples,SQL Alias, Views, Union, Union all, aggregate functions, Operators, SQL exists,<br>**Introduction to HP-Vertica Database**, Vertica Analytics Platform, Columnar Orientation, Advanced Compression, High Availability, Automatic Database design, Massively Parallel Processing, Application Integration.<br>**Hands on sessions**<br>a) Creation of tables with constrains and insertion of values into tables<br>b) Hands-on DML commands to apply different aggregate function, Group by-Having-Order by clause, Operators.<br>c) Creation of views and working with joins | 9 | **CO1, C02** |
| 2 | **HP Vertica- 1**<br>Projections, Query Execution ,Vertica Transactions, Hybrid data store – WOS & ROS,<br>**Projection Design**: Projection fundamentals, Projection types, Projection properties, Replication and Segmentation<br>Database Designer, Comprehensive mode, Incremental mode, Sample data, Sample queries, DBD Advantages<br>**Hands on sessions**<br>a) Creation of schema, tables and execution of SQL statements on Vertica Database,<br>b) Running Database designer<br>c) Hands-on projections | 9 | **CO2, CO3** |
| 3 | **HP Vertica -2**<br>Loading data via INSERT-COPY-MERGE, Deleting data in Vertica- delete vector, design for delete, process of deleting Truncate, Purge, Update, Partitioning, Tuple Mover- MoveOut Parameter, MergeOut Parameter, Working with Vertica Management Console.<br>**Hands on sessions**<br>a) Loading data files from different sources to Vertica database.<br>b) Verifying the log files after loading the data into Vertica database. | 9 | **CO3, CO4** |
| 4 | **Big Data Analytics with Hadoop**<br>Big data overview, Introduction to Hadoop, Overview of Hadoop Distribution File Systems[HDFS] and Map reduce Operations Clustering types in Hadoop- Standalone mode, Pseudo distributed mode, Fully distributed mode.<br>**Hands on Sessions :**<br>Verifying Hadoop installation (Pseudo distributed mode)<br>Java path, Hadoop location, Hadoop configuration files, Name Node setup, Job Tracker, Metadata files, Accessing Hadoop on browser | 9 | **CO5** |

| 5 | **Hadoop Ecosystem**<br>Introduction to SQOOP, Overview of PIG – modes of pig, when to use PIG latin, Introduction to HIVE- data types, architecture, Introduction to HBASE- comparison of Hadoophdfs and HBASE, how data stored in HBASE .<br><br>**Hands on Sessions :**<br>a) Moving data from local file system to Hadoop file system<br>b) Performing MAP Reduction operation in Hadoop<br>c) Verification of operation results through terminal and browser | 9 | **CO6** |
|---|---|---|---|

**REFERENCES**

1. Boris lublinsky, Kevin t. Smith, AlexeyYakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2016.
2. Chris Eaton,Dirkderooset al. , "Understanding Big data ", McGraw Hill, 2016.
3. Tom White, "HADOOP: The definitive Guide", O Reilly 2015.
4. Efraim Turban , Jay E. Aronson , Ting-Peng Liang, "Decision Support Systems & Intelligent Systems", 9th edition, Prentice Hall, 2014.

**EVALUATION**

**CIE - Continuous Internal Evaluation (50 Marks)**

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

**SEE – Semester End Examination (50 Marks)**

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

## VM ware Virtualization Essentials-1

**Course Code:  NHOP02Credits: 04**

**L:P:T:S : 3:0:0:1**                                           **CIE Marks: 50**

**Exam Hours: 3**                                               **SEE Marks: 50**

**Course Outcomes: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Understand the common terms and definitions of Operating System, Cloud Computing and Virtualization. |
| **CO2** | Learning the business benefits and considerations of VMware virtualization. |
| **CO3** | Knowing various approaches to server virtualization, its relevance to the modern data center, available platforms and important features. |
| **CO4** | Analyzing the implications of virtualization on Data Center Challenges. |
| **CO5** | Enable to configure the VMware vSphere storage and network virtualization. |

**Mapping of Course Outcomes to Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 2 | 2 | 1 | - | - | 1 | 2 | 1 | 1 |
| **CO2** | 2 | 2 | 2 | 2 | 2 | 1 | - | - | 1 | 2 | 1 | 1 |
| **CO3** | 2 | 2 | 2 | 2 | 2 | 1 | - | - | 1 | 2 | 1 | 1 |
| **CO4** | 2 | 2 | 2 | 2 | 2 | 1 | - | - | 1 | 2 | 1 | 1 |
| **CO5** | 2 | 2 | 2 | 2 | 2 | 1 | - | - | 1 | 2 | 1 | 1 |

**Mapping of Course Outcomes to Program Specific Outcomes(PSOs):**

| | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 1 |
| **CO3** | 3 | 2 | 1 |
| **CO4** | 3 | 2 | 1 |
| **CO5** | 3 | 2 | 1 |

| Module No | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **Understanding Virtualization: Operating Systems Essentials:** Process Management, Memory Management, Storage Management. **Cloud Computing Essentials:** Introduction to Cloud Computing, Cloud Deployment Models, Challenges. **Virtualization Essentials:** Importance of Virtualization, Examining today's trends, Virtualization Software Operations: Virtualizing Servers, Virtualizing Desktop, Virtualizing Applications. | 8 | CO1 |
| | **List of programs:**<br>    1.  Using vSphere Web Client.<br>    2.  Creating a Virtual Machine. | 4 | |
| 2 | **VMware vSphere Virtualization Overview: Introduction to Data Center** | 9 | CO2 |

| | | | |
|---|---|---|---|
| | **Virtualization:** Traditional Architecture, Virtual Architecture, Types of Virtualization**. Understanding Hypervisors:** Describing hypervisor, Type-1 Hypervisor, Type-2 Hypervisor**. vSphere Products & Features:**vSpherevMotion, vSphere HA, vSphere DRS, vSphere FT, vSphere replication, vSphere data protection. | | |
| | **List of programs:**<br>1. Deploying Virtual Machines Using Cloning, Templates, and a Content Library<br>2. Modifying Virtual Machine Settings | 4 | |
| 3 | **Creating & Managing Virtual Machines: Creating, Managing,Monitoring & Configuring VM:** vSphere Client and vSphere Web Client, vSphere Web Client UI, **Creating VM:**VM Components,<br>Installing Guest OS, **ManagingVM:**Startup and Shutdown of VM's, Creating and | 9 | CO3 |
| | Managing Snapshots, RDM, **Configuring VM:** Memory/CPU Hot Plug, Swap Files**. Creating Clones, Templates & Content Libraries**Cloning VM, Creating Templates, OVF Templates, Types of Content Library. | 4 | |
| 4 | **vSphere Solutions to Data Center Challenges: Data Center Challenges:** Availability, Scalability, Optimization, Management, Application Upgrade & Cloud Challenges.<br>**vSphere for Scalability and Business Continuity:**<br>vSpherevMotion, vSphere HA, vSphere DRS, vSphere FT, vSphere replication, vSphere data protection. | 9 | CO4 |
| | **List of programs:**<br>1. Managing Tasks, Events, and Alarms<br>2. Using vSpherevApps, Managing Multitiered Applications | 4 | |
| 5 | **Understanding VMware vSphere Storage & Network Virtualization Storage Virtualization:** Storage Concepts, iSCSI Concepts, NFS Data stores, VMFS Data stores, Virtual SAN Data stores, Virtual Volume **Network Virtualization:** Introduction to vSphere Standard Switch,Configuring Standard Switch Policies, Introduction to vSphere Distributed Switch | 9 | CO5 |
| | **List of programs:**<br>1. Using vSpherevMotion and Storage vMotion to Migrate VirtualMachines<br>2. Implementing a vSphere DRS Cluster | 4 | |

**TEXT BOOKS:**

1. Nick Marshall, Scott Lowe (Foreword by) with Grant Orchard, Josh Atwell, **Mastering VMwarevSphere 6** ,Publisher:Sybex; 1 edition (24 March 2015).
2. Matthew Portnoy, **Virtualization Essentials** , 2nd Edition, Wiley India Pvt. Ltd.

REFERENCES:
1. Thomas Kraus, KamauWanguhu, Jason Karnes , VMware Network Virtualization: Connectivity for the Software-Designed Data Center , VMwarePressTechnology 1$^{st}$ Edition.
2. Bill Ferguson ,vSphere 6 Foundations Exam Official Cert Guide (Exam #2V0-620): VMware Certified Professional 6 VMware Press , 1st Edition.

**EVALUATION**

### CIE - Continuous Internal Evaluation (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

### SEE – Semester End Examination (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

# Adobe Experience Manager - 1

**Course Code:  NHOP03**                    **Credits: 04**

**L:P:T:S       : 3:0:0:1**                **CIE Marks: 50**

**Exam Hours: 3**                    **SEE Marks: 50**

**Course Outcomes: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Gain a fresh perspective on online marketing in a global scenario. Understand the concepts of object oriented programming in JAVA. |
| **CO2** | Understand the programming concepts in Web scripting languages and will be able develop web pages using scripting languages. |
| **CO3** | Understand the architecture, technologies and frameworks in Adobe Experience Manager. |
| **CO4** | Create online webpages, Digital asset management and campaigning using AEMIntegrate new digital marketing techniques into the strategic marketing plan using AEM. |
| **CO5** | Drive change and foster innovation in Digital Marketing with AEM |

**Mapping of Course Outcomes to Program Outcomes:**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |
| **CO2** | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |
| **CO3** | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |
| **CO4** | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |
| **CO5** | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |

**Mapping of Course Outcomes to Program Specific Outcomes(PSOs):**

| | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|
| **CO1** | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 1 |
| **CO3** | 3 | 2 | 1 |
| **CO4** | 3 | 2 | 1 |
| **CO5** | 3 | 2 | 1 |

| Module No | Module Contents | Hours | COs |
|---|---|---|---|
| | **Introduction to DM & AEM**<br>**Getting started with DM:** What is online marketing? Characteristics of good domain name? What is digital marketing? Different methods of digital Marketing, Main methods of DM, Search engine optimization, pay per click & display advertising, email marketing, content marketing, social media marketing.<br>**Introduction Object Oriented Programming with JAVA**<br>**Fundamentals:** Class Objects, Methods, Constructor, this reference, inheritance, and polymorphism,Introduction to JSP | 8 | |
| | **Hands on :**<br>1. Write a program to calculate and area of four different geometric shapes: triangles, squares, rectangles, and circles.Use Method overriding.<br>2. Employee program to create n object to find gross salary. Data: empid,empname,gender,basic,hra = 25% of basic, DA = 125% of basic,CCA=Rs 300, IT=10% if gross >1L.<br>• Display all information.<br>• Use constructors<br>• Implement required methods.<br>3. Student program to create n objects to find Grade. Data:usn,studname,sem,sub name[ ],sub marks[],percentage, Grade. 90 - 100 = S<br>80 − 89 = A<br>70-79 =B<br>60 − 69 = C<br>50 − 59 = D<br>40 − 49 =E<br>< 40 = F | 4 | CO1 |
| 2 | **Introduction to Scripting Languages:**<br>**Web and XHTML:**Internet, WWW, Web Browsers and Web Servers, URLs, HTTP, **XHTML:** Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links, Lists, Tables, Forms, Frames<br>**CSS:**Introduction,Levels of style sheets,formats,selectorforms,The box model,conflict resolution<br>**Javascript:** Overview , Object orientation and Javascript, Syntactic characteristics, Primitives, operations, and expressions, Screen output and keyboard input, Control statements, Arrays, Functions, Pattern matching using regular expressions, Errors in scripts.**Introduction to Sightly** | 9 | CO2 |
| | **Hands on:**<br>1. Create a web page using HTML forms for email registration.<br>2. Create a web page using HTML frames.<br>3. Develop a XHTML file that includes Javascript script for thataccepts a number n using prompt and outputs the first nFibonacci numbers<br>4. Develop a XHTML file that includes Javascript script for thataccepts a number n using prompt and outputsa table of numbersfrom 1 to n and their squares using alert<br>5. Develop a web page usingHTML and apply the various CSS styles.<br>6. Develop a web page usingHTML and apply selector forms. | 4 | |

| 3 | **Getting started with AEM:** Introduction to Web content management, History of AEM ,The adobe marketing cloud, Install & deploy AEM, Author Instance, Publish Instance,AEM Consoles: Authoring in AEM, work with user interfaces: Classic UI, Touch optimized UI, AEM web console: OSGi management console, CRX Explorer, CRXDE Lite<br>**AEM Architecture**<br>**OSGi framework**: Introduction ,AEM functional building blocks, Architecture stack, OSGi framework.<br>**Content Repository:** JCR, Jackrabbit Oak, Adobe CRX**Web**<br>**Framework:** REST, Apache Sling. | 9 | CO3 |
|---|---|---|---|
| | **Hands on:**<br>   **1.** AEM installation & deployment.<br>   **2.** Working in AEM Environment<br>   **3.** Familiarize yourself with a Repository structure.<br>   **4.** Create a Node and add properties. | 4 | |
| 4 | **Managing Content**<br>**AEM Authoring Framework —**Templates, Create Templates, Components and Design ,components ,Create a Page-Rendering Component ,Modularize the Page Component ,Inheriting Foundation Components , Design , Adding a design to a page ,Creating Components and Include them in Scripts, Create a Top Navigation Component, Dialog Boxes ,Create Dialog Boxes for Components, Dialog Box -Classic-UI, touch-optimized UI ,Use Design Dialog Boxes for Global Content , Create a logo component. | 9 | CO4 |
| | **Hands On**<br>  1. Create the Structure of Your Website 2.<br>  2. Create a Template for Your Website<br>  3. Create a Page-Rendering Component<br>  4. Create a Website Structure<br>  5. Modularize the Page Component<br>  6. Inherit the Sightly Foundation Component Page<br>  7. Add a Design to the Page<br>  8. Create a Top Navigation Component and Include it in a Script<br>  9. Create a Training Title Component<br>  10. Create a Logo Component | 4 | |
| 5 | **Digital Asset Management, Mobile pages, Managing Campaign :**<br>Introduction to DAM, Basic DAM functions, DAM Metadata, DAM Components, Finding Assets, Asset Management, Adding New content, Authoring Responsive& Mobile Pages,Managing Campaigns& Content Targeting. | 9 | CO5 |
| | **Hands on:**<br>  1. Create and customize asset share page<br>  2. Add a predicate to the asset share page<br>  3. Add an asset editor page<br>  4. Versioning for assets<br>  5. Create folders<br>  6. Add CUG properties to folders<br>  7. Use tags to organize assets<br>  8. Edit images | 4 | |

| | | 9. Upload thumbnail<br>10. View references to assets<br>11. Edit metadata of an asset<br>12. Create a Page<br>13. Insert a New Paragraph<br>14. Edit the next Paragraph<br>15. Add an image from the content finder<br>16. Insert an image from your file system<br>17. Add more Components<br>18. Annotate a component<br>19. Move or delete a component<br>20. Working with responsive page Layout<br>21. Create a Mobile page<br>22. Add content to Mobile Page<br>23. Creating brand<br>24. Creating campaign<br>25. Defining a new segment<br>26. Create experiences<br>27. Turn a component into targeted component<br>28. Test the campaign | | |

**Text Books:**

1. Ryan D Lunka**,—Adobe Experience Manager: Classroom in a Book—,** 2014, Adobe Press .
2. Shane closser ,**Adobe Experience Manager: Quick Reference Guide** , 2014, Adobe Press .
3. Shivanikarwal, **Digital Marketing Handbook** , 2015 , CreateSpace Independent PublishingPlatform.
4. RobertW.Sebesta , **Programming the World Wide Web** ,4th Edition, PearsonEductaion2008
5. M.Deitel,P.JDeitel,A.B.Goldberg, **Internet and World Wide Web How to Program**,4<sup>th</sup>Edition,PearsonEductaion , 2004
6. Shivanikarwal , **Digital Marketing Handbook:A Guide to Search Engine Optimization,Pay Per Click Marketing, Email Marketing, Social Media Marketing and ContentMarketing** , 2015 , CreateSpace Independent Publishing Platform
7. HerbertSchield ,**—Java:The Complete Reference** , 9th Edition,OraclePress,Tata McGraw Hill.

**EVALUATION**

**CIE - Continuous Internal Evaluation (50 Marks)**

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

**SEE – Semester End Examination (50 Marks)**

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

**Big Data Analytics Using HP Vertica- 2**

Code : NHOP04                                                     Credits: 04

L:P:T:S : 3:0:0:1                                             CIE Marks: 50

Exam Hours : 3                                               SEE Marks: 50

**Course Outcomes: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Demonstrate Hadoopfilesystem and mapreduce programs |
| **CO2** | Demonstrate the working of SQOOP tool |
| **CO3** | Apply Pig shell commands and operators |
| **CO4** | Creating and running Pig Latin scripts |
| **CO5** | Demonstrate HIVE commands and creating tables in HIVE |
| **CO6** | Perform handson practice on HBase commands |

**Mapping of Course Outcomes to Program Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 1 | - | 3 | 2 |
| **CO2** | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 1 | - | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 1 | - | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 1 | - | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 2 | 3 | 2 | -- | - | 1 | - | 3 | 2 |
| **CO6** | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 1 | - | 3 | 2 |

**Mapping of Course Outcomes to Program Specific Outcomes(PSOs):**

| | PSO1 | PSO2 |
|---|---|---|
| **CO1** | 3 | 3 |
| **CO2** | 3 | 3 |
| **CO3** | 3 | 3 |
| **CO4** | 3 | 3 |
| **CO5** | 3 | 3 |
| **CO6** | 3 | 3 |

| Module No. | Module Contents | Hours | COS |
|---|---|---|---|
| 01 | **VERTICA &Hadoop Review**<br>**Vertica Cluster Management:** Adding nodes to an existing cluster, Removing nodes from a cluster, Replacing nodes, Node recovery in vertica, Rebalancing data across nodes<br>**Hands on sessions**<br>Check hadoop configuration file<br>Load a .csv file from local file system to hadoopfile system<br>Perform analysis on loaded files using hadoopmapreduce programs and verify the output using hadoop commands as well as browser<br>• Count<br>• Grep<br>**SQOOP**<br>Verifying Sqoop status through clouderamanager<br>Hand-on Practice on various Sqoop basic commands<br>• List-database<br>• List-table<br>• Eval<br>Import of tables from Mysql database to hdfs<br>• Import of all tables<br>• Import of specific tables to default directory /target directory<br>• Import of subset of tables using "where" clause<br>• Import table as sequence file<br>• Incremental import<br>Export files from hdfs to mysql database | 09 | CO1, CO2 |
| 02 | **Apache Pig Architecture**: -Apache Pig components, PigLatin Data Model: atom, tuple, bag, relation, map.<br>**Basic grunt shell commands,** Running local mode - mapreduce mode,<br>**Pig Latin 1:** Pig Latin Statements: **Data types-** simple &Complex Data Types<br>**Hands on sessions:**<br>**Operators (Part 1) :**<br>Loading and storing - from/to local file system, from/to hdfs<br>Diagnostic operator – Dump, Describe, Explain, illustrate<br>• Filtering – filter operator; For Each Generate<br>operator: projection, nested projection, schema; Distinct Operator<br>Arthematic operators<br>Comparision operator<br>Boolean Operators | 09 | CO3 |
| 03 | **Hands on Sessions:**<br>**Operators (Part 2) :**<br>Grouping & Joining Operator – GROUP, COGROUP, JOIN(INNER, SELF JOIN)<br>Combining & splitting – UNION, SPLIT<br>Sorting – ORDER BY, LIMIT<br>**Pig Latin Built-in functions:**<br>**Eval functions:** AVG, SUM, MIN, MAX, COUNT, SIZE, CONCAT, DIFF, SUBTRACT, ISEMPTY, TOKENIZE | 09 | CO4 |

| | | | |
|---|---|---|---|
| | ☐☐**Bag&Tuple Functions:** TOTUPLE, TOBAG, TOMAP<br>☐☐**String Functions:** ENDSWITS, STARTSWITH, SUBSTRING, EQUALSIGNORECASE, INDEXOF, LCFIRST(), UCFIRST(), UPPER(), LOWER(), REPLACE()<br>☐☐**Math Functions:** ABS, CBRT, SQRT, COS, SIN, TAN, CEIL, FLOOR, EXP, LOG, LOG10, ROUND<br>**Apache Pig - Running Scripts:**<br>☐☐Creating pig script<br>☐☐Commenting pig script<br>☐☐Executing –running pig script – with/without parameters<br>☐☐Sample examples: word count program using pig script, count of similar events from a log file, simple twitter case study example. | | |
| 04 | **HIVE**<br>**Hive:** Why hive? , components of hive, simple architecture of hive, data-model of hive(database, table, partition, bucket)<br>**Hands on Session**:<br>**Hive Commands :**<br>*Data Definition Language (DDL )*<br>☐☐CREATE database/ table/ external table , DROP, TRUNCATE, ALTER, SHOW, DESCRIBE Statements.<br>☐☐Create table with partition by, clustering by commands<br>*Data Manipulation Language (DML )*<br>☐☐LOAD, INSERT Statements- INSERT INTO, INSERT OVERWRITE<br>*Built-in Operators*- Relational Operators- Arithmetic Operators- Logical Operators - Complex Operatorsexample: simple queries on these operators<br>*Order by clause- Group by clause*- aggregate functions(sum, avg, count, min, max)<br>**Joins, Create and drop of views , index** | 09 | CO5 |
| 05 | **HBASE : Various types of No SqlDatabses – when HBASEis used? - HBase Data Model**(Table, Rowkey, Columnfamilies, Column qualifiers, Cell, Timestamp)<br>**Hands on Sessions:**<br>☐☐HBase shell Command: Create table with /without version –<br>☐☐put command<br>☐☐get command with / without version<br>☐☐Scan command<br>☐☐delete column – column family<br>☐☐disable – enable<br>☐☐drop table | 09 | CO6 |

**EVALUATION**

## CIE - Continuous Internal Evaluation (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

## SEE – Semester End Examination (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

# VMware Virtualization Essentials -2

**Course Code : NHOP05**                                                      **Credits: 04**

**L:P:T:S: 3:0:0:1**                                                          **CIE Marks: 50**

**Exam Hours : 3**                                                           **SEE Marks: 50**

**Course Outcomes: At the end of the Course, the Student will be able to:**

| CO1 | Learn the common terms and definitions of data center, vSphere Virtual infrastructure |
|-----|----------------------------------------------------------------------------------------|
| CO2 | Learning the vCenter Server architecture, virtual machine and importance of VMware tools |
| CO3 | Analyzevirtual machine management, resource management and monitoring. |
| CO4 | Learning vSphere products and solutions for protecting data |
| CO5 | Enable to configure the VMware vSphere products and solutions |

## Mapping of Course Outcomes to Program Outcomes

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | 2   | 1    | -    | 2    |
| CO2 | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | 2   | 1    | -    | 2    |
| CO3 | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | 2   | 1    | -    | 2    |
| CO4 | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | 2   | 1    | -    | 2    |
| CO5 | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | 2   | 1    | -    | 2    |

| Module No | Module Contents | Hours | COs |
|-----------|-----------------|-------|-----|
| 1 | **Introduction to vSphere and the Software-Defined Data Center:** Describe the topology of a physical data center, Explain the vSphere virtual infrastructure, Define the files and components of virtual Machines, Describe the benefits of using virtual machines, Explain the similarities and differences between physical architectures and virtual architectures, Define the purpose of ESXi, Define the purpose ofvCenter Server, Explain the software-defined data center, Describe private, public, and hybrid clouds. | 8 | CO1 |
|   | **List of programs:** <br> 1. Using vSphere Web Client. | | |
| 2 | **vCenter Server:** Introduce the vCenter Server architecture, Deploy and configure vCenter Server Appliance, Use vSphere Web ClientBackup and restore vCenter Server**,** Examine vCenter Server permissions and rolesExplain the vSphere HA architectures and features,Examine the new vSphere authentication proxy**,** Manage vCenter Server inventory objects and licenses**,** Access and navigate the new vSphere clients**.** <br><br> **Creating Virtual Machines:** Introduce virtual machines, virtual machine hardware, and virtual machine filesIdentify the files that make up a virtual machine, Discuss the latest virtual machine hardware and its features, Describe virtual machine CPU, memory, disk, and network resource usage, Explain the importance of VMware Tools™, Discuss PCI pass-through, Direct I/O, remote direct memory access, and NVMe, Deployand configure | 9 | CO2 |

| | | | |
|---|---|---|---|
| | virtual machinesand templates, Identify the virtual machine disk format. | | |
| | **List of programs:**<br>1. Creating a Virtual Machine.<br>2. Manage vCenter Server inventory objects | | |
| 3 | **Virtual Machine Management**: Use templates and cloning to deploy new virtual machines, Modify and manage virtual machines, Clone a virtual machine, Upgrade virtual machine hardware to version 12, Remove virtual machines from the vCenter Server inventory and datastore, Customize a new virtual machine using customization specification files, Perform vSpherevMotion and vSphere Storage vMotion migrations, Create and manage virtual machine snapshots, Create, clone, and exportvApps, Introduce the types of content libraries and how to deploy and use them. | | |
| | **List of programs:**<br>1. Create clone, templates and manage virtual machines<br>2. Perform vSpherevMotion migrations. | | |
| 4 | **Resource Management and Monitoring:** Introduce virtual CPU and memory concepts, Explain virtual memory reclamation techniques**,** Describe virtual machine over-commitment and resource competition**,**<br><br>Configure and manage resource pools**,** Describe methods for optimizing, CPU and memory usage, Use various tools to monitor resource usage**,** Create and use alarms to report certain conditions orevents**,** Describe and deploy resource pools, Set reservations, limits, and shares**,** Describe expandable reservations**,** Schedule changes to resource settings**,** Create, clone, and export vApps, Use vCenter Server performance charts and esxtop to analyzevSphere performance. | 9 | CO3 |
| | **List of programs:**<br>1. Create virtual machine snapshots<br>2. Manage resource and monitoring of virtual CPU and memory concepts | | |
| 5 | **vSphere HA, vSphere Fault Tolerance,and Protecting Data:** Explain the vSphere HA architecture**,** Configure and manage a vSphere HA cluster**,** Use vSphere HA advanced parameters**,** Define clusterwide restart ordering capabilities**,** Enforce infrastructural or intra-app dependenciesduring failover**,** Describe vSphere HA heartbeat networks and datastore heartbeats**,** Introduce vSphere Fault Tolerance**,** Enable vSphere Fault Tolerance on virtual machines**,** Support vSphere Fault Tolerance interoperability with vSAN**,** Examine enhanced consolidation of vSphere<br><br>Fault Tolerance virtual machines, Introduce vSphere Replication, Use vSphere Data Protection to back up and restore data. | 9 | CO4<br>CO5 |
| | **List of programs:**<br>1. Perform vSphere HA<br>2. Perform vSphere Fault Tolerance | | |

**TEXT BOOKS:**

1. Nick Marshall,Scott Lowe(Foreword by) with Grant Orchard,Josh Atwell, "**Mastering VMware vSphere 6**",Publisher:Sybex; 1 edition (24 March 2015).

2. Matthew Portnoy, "**Virtualization Essentials**", 2nd Edition, Wiley India Pvt. Ltd.

REFERENCES:
1. Thomas Kraus,KamauWanguhu,Jason Karnes,"**VMware Network Virtualization: Connectivity for the Software-Designed Data Center**", VMware Press Technology 1$^{st}$Edition.
2. Bill Ferguson,"**vSphere 6 Foundations Exam Official Cert Guide (Exam #2V0-620): VMware Certified Professional 6 VMware Press**", 1st Edition.

**EVALUATION**

### CIE - Continuous Internal Evaluation (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

### SEE – Semester End Examination (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

## Adobe Experience Manager – 2

**Course Code : NHOP06**  **Credits: 04**

**L:P:T:S: 3:0:0:1**  **CIE Marks: 50**

**Exam Hours : 3**  **SEE Marks: 50**

**Course Outcomes: At the end of the Course, the Student will be able to:**

| CO1 | Learn to write a server side java application called JSP to catch form data sent from client and store it on database. |
|---|---|
| CO2 | Learn to develop a dynamic webpage by the use of java script and HTML5. |
| CO3 | Demonstrate a server side java application called Servlet to catch form data sent from client, process it and store it on database and write scripts using perl |
| CO4 | Building Web applications with PHP |
| CO5 | Gain an understanding of search engine algorithms and how they affect organic search results and websites. |

**Mapping of Course Outcomes to Program Outcomes**

|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |
| CO2 | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |
| CO3 | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |
| CO4 | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |
| CO5 | 2 | 3 | 2 | 3 | 1 | 2 | -- | - | - | 2 | 2 | 1 |
| CO6 | 2 | 3 | 2 | 3 | 1 | 2 | - | - | - | 2 | 2 | 1 |

**Mapping of Course Outcomes to Program Specific Outcomes(PSOs):**

|  | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO1 | 3 | 2 | 1 |
| CO2 | 3 | 2 | 1 |
| CO3 | 3 | 2 | 1 |
| CO4 | 3 | 2 | 1 |
| CO5 | 3 | 2 | 1 |

| Module No. | Module Contents | Hours | COS |
|---|---|---|---|
| 1 | Java Server Pages (JSP)<br>Introduction, Advantages of JSP, Developing First JSP, JSP Scripting Elements- (Directives, Declaratives, Scriplets, Expressions, Implicit Variables), Page Directives.<br>*Java Server Pages Standard Tag Library*: Why you should use the JSTL, JSTL Expression Language, Core ags, custom tag Libraries: why custom Tags, Tag Library basics, how are tags being used, new and old custom tags, Tag library Descriptors (TLDs), simple JSP 2.0 custom tags. | 9 | **CO1** |
| 2 | Introduction to HTML5<br>Overview, Browser Support, New features, Backward compatibility, Syntax, The DOCTYPE, Character Encoding, The <script> tag, The <link> tag, HTML5 Elements, HTML5 Document, HTML5 Attributes: Standard Attributes, Custom Attributes, HTML5 EVENTS, Iframes, WEB FORMS 2.0, SVG, MathML, Web Storage, Server Sent Events, WebSockets. | 9 | **CO2** |
| 3 | Building Web applications with PHPOrigins and uses of PHP, Overview of PHP, General syntactic characteristics, Primitives, operations and expressions, Output, Control statements, Arrays, Functions, Pattern matching, Form handling. *Building Web applications with PHP:* File handling, Tracking users, cookies, sessions, Using Databases, Handling XML. | 9 | **CO4** |
| 4 | Perl for web development:<br>Origins and uses of Perl, Scalars and their operations, Assignment statements and simple input and output, Control statements, Fundamentals of arrays. *Advanced concepts of Perl:* Hashes, References, Functions, Pattern matching, File input and output; Examples. | 9 | **CO3** |
| 5 | Planning a powerful Search Engine Strategy-SEOInvestigating Search Engines and Directories, Where Do People Search?, Search Engine Magic,<br>Gathering Your Tools. Understanding the Limitations, Eyeing the Competition, Going Beyond Getting to #1, Controlling Search Engine Variables, Determining Your Plan of Attack, Look Away a Few Minutes. *Making Your Site Useful and Visible:* Learning from Amazon, Revealing the Secret But Essential Rule of Web Success, Making Your Site Work Well, Panda-Google Endorses Good Design. | 9 | **CO5** |

**TEXT BOOKS:**

1. The Art of SEO Mastering Search Engine Optimization by Eric Enge, Stephan Spencer, and Jessie C. Stricchiola, 3rd Edition, O"Really.
2. HTML5 for Masterminds, J.D. Gauchat, Revised 3rd Edition, MinkBooks, 2014, ISBN: 154292331X.
3. Core Servlets and Java Server Pages. Volume 1: Core Technologies, Marty Hall, Larry Brown, Prentice Hall, 2nd Edition, 2013.
4. Web Programming Building Internet Applications, Chris Bates, 3rd Edition, Wiley India, 2012.

**EVALUATION**

### CIE - Continuous Internal Evaluation (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

### SEE – Semester End Examination (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

**SAP**

Course Code : NHOP07                                      Credits      : 04
L:P:T:S          : 3:0:0:1                                 CIE Marks: 50
Exams Hours : 03                                           SEE Marks: 50

**COURSE OUTCOMES: At the end of the course, the students will be able to:**

| CO1 | Understand the concept of production system and facilities, automation, Computer Aided Process planning (CAPP), Material Requirement Planning (MRP), Master Production Schedule (MPS), capacity planning |
|-----|---|
| CO2 | Understand SAP system along with its navigation in the software |
| CO3 | Create master data for new vendor and new trading goods in Materials Management |
| CO4 | Evaluate and create production order for the product group |
| CO5 | Create master data for new customer |
| CO6 | Facilitate the flow of goods between producer and the purchaser for near fail proof logistic operations |

**Mapping of Course outcomes to Program outcomes:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO6 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 |

| Module No. | Contents of Module | Hrs | COs |
|---|---|---|---|
| 1 | **Computer Integrated Manufacturing Systems:** Introduction, Production system facilities, Manufacturing support system, Automation definition, Types of Automation, Reasons for Automation, limitations of Automation, Automation principles & Strategies, CIM, Information Processing Cycle in Manufacturing, Production concepts<br>**Computerized Manufacturing Planning System:** Introduction, Computer Aided Process Planning, Retrieval types of process planning, Generative type of process planning, Material requirement Planning, Fundamental Concepts of MRP, Inputs to MRP, Capacity planning. | 07 | CO1 |
| 2 | **Introduction to SAP**: Case study of Global bike group (GBI),<br>**Materials Management (MM) Case study**: Creation of new vendor, Creation of material master for trading goods, create purchase requisition, creating request for quotation, Create and display purchase order, create and verify goods receipt for purchase order, create invoice receipt from vendor, post payments to vendor, display and review goods ledger account balances | 07 | CO2,CO3 |
| 3 | **Production Planning and Execution (PP) Case study:**<br>Change material master record, change routing, display product group, creating sales and operation plan, Transfer SOP to demand management, Review demand management, Run MPS with MRP, Review stock and requirement list, convert planned order into production order, receiving goods from inventory, issuing goods to production order, review production order status, confirm production completion, receive goods from production order, review costs assigned to production order, settle costs of production order. | 07 | CO4 |
| 4 | **Sales and Distribution (SD) Case study:**<br>Creation of new customer, create contact person for customer, changing the customer, create customer inquiry and quotation, create sales order referencing for quotation, check stock status, display sales order, start delivery process, pick materials on delivery note, post goods issue, create invoice for customer, display billing document and customer invoice, post receipt of customer payment, review the document flow | 06 | CO5 |
| 5 | **Warehouse Management (WM) Case study:**<br>Create purchase order, display material inventory, display material inventory value, receive the goods, display material inventory and value, run bin status report, create transfer order, confirm transfer order | 06 | CO6 |

**TEXT BOOKS:**

1. **Automation, Production System & Computer Integrated Manufacturing,** M. P. Groover, Person India, 2015, 3rdEdition.

2. **Principles of Computer Integrated Manufacturing**, S. Kant Vajpayee, Prentice Hall India.
3. **A beginner's guide to SAP**, Martin Munzel, SydneyMcConnel
4. **Online course material for SAP**
**EVALUATION**

## CIE - Continuous Internal Evaluation (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

## SEE – Semester End Examination (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

## Schneider - Industrial Automation

**Course Code :NHOP08**

**L:P:T:S        : 3:0:0:1**

**Exam Hours : 03**

**Credits      : 04**

**CIE Marks   : 50**

**SEE Marks   : 50**

**Course Outcomes: At the end of the Course, the Student will be able to:**

| CO1 | Understand the architecture of an industrial automation system |
|------|------------------------------------------------------------------|
| CO2 | Design a PLC application using ladder diagram language according to a specification |
| CO3 | Design a PLC application using SFC diagram language according to a specification |
| CO4 | Use Unity Pro to program and test an application |
| CO5 | Use Vijeo Designer to program and test an application |

**Mapping of Course Outcomes to Program Outcomes:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 2 | 3 | 3 | 1 | 3 | - | - | - | - | 2 | - | - |
| CO2 | 2 | 3 | 3 | 1 | 3 | - | - | - | - | 2 | - | - |
| CO3 | 2 | 3 | 3 | 1 | 3 | - | - | - | - | 2 | - | - |
| CO4 | 2 | 3 | 3 | 1 | 3 | - | - | - | - | 2 | - | - |
| CO5 | 2 | 3 | 3 | 1 | 3 | - | - | - | - | 2 | - | - |

| Module | Contents of the Module | Hours | COs |
|--------|------------------------|-------|-----|
| 1 | **Basics of Automation:** Control Systemsand Automation Strategy Evolution of instrumentation and control, role of automation in industries, benefits of automation. **Structure of PLC:** Introduction, architecture, definition of discrete state process control, PLC Vs PC, PLC Vs DCS. Practical activities: oApplication to Schneider M340 pedagogic bench and wiring of input and output. | 8 | CO1 CO4 |

| | | | |
|---|---|---|---|
| **2** | **Instrumentation Standard Protocols:**<br>Definition of protocol, Introduction to Open System Interconnection (OSI) model, Communication standard (RS232, RS485), Modbus (ASCll/RTU), Introduction to third party interface, concept of OPC (Object linking and embedding for Process Control).<br> Practical activities: oAnalysis of a PLC configuration and communication **devices**<br><br>**Sensors in industrial automation:**<br>Types and characteristics of most used sensors in industry. Application to sensors in PLC environment. Practical activities: oAnalysis of several sensors (technologies, performances, …) and connections to PLC | 9 | CO1<br>CO4 |
| **3** | **Ladder and FBD programming languages:**<br>Introduction to PLC programming ladder and FBD methods as per IEC 61131.<br> Practical activities:<br>oBasic logic operations under Unity ProEnvironment, oTimers/counters functional bloc, oApplications with M340 Bench, oApplication with surface treatment industrial device. | 9 | CO1<br>CO2<br>CO4 |
| **4** | **SFC programming language:**<br>Introduction to PLC programming SFC method as per IEC 61131.<br> Practical activities:<br>oBasics Applications under Unity Pro environment, oApplications with M340 Bench, oApplication with surface treatment industrial device. | 9 | CO1<br>CO3<br>CO4 |
| **5** | **HMI development:**<br>Introduction of HMI in Industrial Automation.<br> Practical activities:<br>oApplications with Vijeo Designer Environment, oApplications with M340 Bench, oApplication with surface treatment industrial device. | 9 | CO1<br>CO5 |

**Text books:**

1. Programming Industrial Control Systems Using IEC 1131-3 (I E E CONTROL ENGINEERING SERIES) Revised Edition,1998 by Robert W. Lewis (Author)
2. Programmable Logic Controllers and Industrial Automation: An Introduction 2nd Edition, 2017 by MadhuchhandaMitra and SamarjtSemgupta.
3. Industrial Controls and Manufacturing (Engineering) 1st Edition,1999 by Edward W. Kamen

**Reference books**:

1. Industrial Instrumentation Paperback, 2nd Edition, 2018 by K Krishnaswamy, S. Vijyachitra.
2. Overview of Industrial Process Automation Paperback,2011 by K.L.S. Sharma
3. Industrial Process Automation Systems 1st Edition,2014 by B.R. Mehta Y. Jaganmohan Reddy

**EVALUATION**

**CIE - Continuous Internal Evaluation (50 Marks)**

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

**SEE – Semester End Examination (50 Marks)**

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

# Cisco- Routing and Switching - 1

**Course Code :NHOP09**

**L:P:T:S        : 3:0:0:1**

**Exam Hours : 03**

**Credits      : 04**

**CIE Marks   : 50**

**SEE Marks   : 50**

**Course Outcomes: At the end of the Course, the Student will be able to:**

| CO1 | Describe the devices and services used to support communications in data networks, Internet and Role of Protocol Network. |
|-----|------|
| CO2 | Design, calculate, and apply subnet masks and addresses to fulfill given requirements in IPv4 and IPv6 network |
| CO3 | Build a simple Ethernet network using routers and switches |
| CO4 | Describe enhanced switching technologies such as VLANs, VLAN Trunking Protocol, |
| CO5 | Describe and analyse the operations of Dynamic Host Configuration Protocol and Domain Name |
| CO6 | Configure and troubleshoot basic operations of a small switched network |

**Mapping of Course Outcomes to Program Outcomes:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 3   | 3   | 3   | 3   | 1   | 1   | -   | 2   | 2    | -    | 3    |
| CO2 | 3   | 3   | 3   | 3   | 3   | 1   | 1   | -   | 2   | 2    | -    | 3    |
| CO3 | 3   | 3   | 3   | 3   | 3   | 1   | 1   | -   | 2   | 2    | -    | 3    |
| CO4 | 3   | 3   | 3   | 3   | 3   | 1   | 1   | -   | 2   | 2    | -    | 3    |
| CO5 | 3   | 3   | 3   | 3   | 3   | 1   | 1   | -   | 2   | 2    | -    | 3    |
| CO6 | 3   | 3   | 3   | 3   | 3   | 1   | 1   | -   | 2   | 2    | -    | 3    |

| Module No | Module Contents | Hours | COs |
|-----------|-----------------|-------|-----|
| 1 | **Introduction to Networks**Introduction to NetworksNetworking Types,OSI Reference Model,TCP/IP ModelConfiguring a Network Operating System ,Physical Layer Protocols ,Data Link Layer Protocols ,Media Access Control, Ethernet Protocol ,Address Resolution Protocol | 9 | CO1 |
|   | **Hands On :**        CCNA LAB 01<br>                    CCNA LAB 02<br>                    CCNA LAB 03 | | |
| 2 | **Connecting Devices and IP Addressing** Introduction to Routers, Switches, IOS and Boot Process ,IPv4 Network Address and IPv6 Network Address ,Subnetting , Addressing Schemes ,Design Consideration for IPv6,Routing : Static, Default and Dynamic , Routing Metrics, Classes of Routing Protocol ,Connectivity Verification | 9 | CO2 |

| | | | | |
|---|---|---|---|---|
| | **Hands On:**<br>Basic Configuration of Router and Switches Use of Command Line Interface Configuring Router Interfaces Gathering Information and Verifying Configuration<br>Saving, Erasing, Restoring and Backing up Configuration & IOS File Troubleshooting IP Address Route Summarization<br>CCNA LAB 04 | | | |
| 3 | **Introduction to IP Routing** Understanding IP Routing, Classes of Routing Protocol, Routing Decision, Router Operation, Static Routing :<br>Implement Static Routes, Dynamic Routing : Dynamic Routing<br>Protocols, RIPv2, RIPv1, Routing table, EIGRP, OSPF | 9 | CO3 |
| | **Hands On:**<br>Routing Initial Configuration<br>Route Redistribution<br>Static and Default Route Lab<br>Configure static and Default Routes<br>Verifying and Troubleshooting RIP<br>Configuring EIGRP<br>Verifying and Troubleshooting EIGRP<br>Open Shortest Path First (OSPF)<br>Configuring OSPF<br>Verifying and Troubleshooting OSPF<br>CCNA LAB 05 :RIP<br>CCNA LAB 06 :EIGRP<br>CCNA LAB 07 :OSPF | | | |
| 4 | **Switching and Spanning Tree Protocol** LAN Design, The Switched Environment Basic Switch Configuration, Switch Security, Understanding Switching and Switches, Types of Switch Ports, Virtual LANs (VLANs) , VLAN Trunking Protocol (VTP) , VLAN Segmentation, VLAN Implementation | 9 | CO4 |
| | **Hands On:**<br>Initial Configuration of a Catalyst Switch<br>Port Security<br>Spanning Tree Protocol<br>VLAN Configuration ,<br>Inter-VLAN Routing Configuration<br>VTP Troubleshooting<br>Voice VLAN Configuration | | | |
| 5 | **Access Control Lists** Introduction to Access Lists, Standard Access Lists, Extended Access Lists, ACL Operation, Standard IPv4 ACLs, DHCP : DHCPv4 and DHCPv6, NAT for Ipv4 : Introduction to NAT, , Device Management and Maintenance : Device Discovery, Device Management, Device Maintenance | 9 | CO5 |

**Hands On:**
 Initial Setup and Access List Lab
 Static NAT Configuration and Verification and Dynamic NAT Configuration
 NAT Configuration
 NAT Troubleshooting
 ACL Troubleshooting
Configuring DNS and DHCP

**TEXT BOOKS:**

1. CCNA Routing and Switching 200-125 Pearson u Certify Course, Wendell Odom, Sean Wilkins, Published Jan 19, 2017 by Cisco Press.

**REFERENCE BOOKS:**

1. CCNA v2.0  R&S Lab Workbook 200-120.
2. Computer Networks, Andrew S. Tanenbaum, Fourth Edition  Pearson Education
3. Data Communications and Networking, BehrouzA.Forouzan, Tata McGraw Hill, 4th Edition

**EVALUATION**

### CIE - Continuous Internal Evaluation (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

### SEE – Semester End Examination (50 Marks)

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

# DATA ANALYTICS

| | | | |
|---|---|---|---|
| **Course Code : NHOP10** | | **Credits** | **: 04** |
| **L:P:T:S**      **: 3:1:0:0** | | **CIE Marks** | **: 50** |
| **Exam Hours : 03** | | **SEE Marks** | **: 50** |

**Course Outcomes: At the end of the Course, the Student will be able to:**

| CO1 | Students should be able to describe the various types of data warehousing and its model. |
|---|---|
| CO2 | Illustrate the various ETL tools available in Data warehousing. |
| CO3 | Students should be able to distinguish between business intelligence and information through value chain. |
| CO4 | Examine the various essentials of business intelligence. |
| CO5 | Recommend the right type of business intelligence tools used for different scenario. |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| **CO2** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| **CO3** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| **CO5** | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |

| Module No | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **Introduction to SQL:** <br> Types of SQL, Constrains, JOINS, Clause, Group by, Having, Order by, Types of JOINS, Where Clause with examples, Writing Functions, Writing Stored Procedures. <br> **Hands on sessions:** Creation and managing tables with the inclusion of JOINS, Clauses, with the use of Constrains. Adding indexes on tables, creating views on tables, Writing Stored procedures. | 09 | CO1 |
| 2 | **Data Modeling:** <br> Modeling techniques, modeling for data marts, overview of the Data Warehouse and Data mart modeling process. Dimensional Modeling, Snowflake and Star Schema. Detailed Dimensional modeling approach. Aggregate Fact Tables, Fact Constellation Schema, the strengths ofDimensional Modeling. The characteristics of dimension table and facttable. Keys in Data warehouse (Star) Schema: Primary Keys, Surrogate Keys, Foreign Keys, Importance of Metadata. | 09 | CO2 |
| 3 | **ETL Fundamentals and Tools:** <br> Extraction of data from source, Transformation of data, Data Cleansing and | 09 | CO3 |

| | | | |
|---|---|---|---|
| | Dimension configuring, Performing calculations on data, Loading data into target storage. Introduction to TALEND and PENTAHO, which are open source ETL tools, supports Vertica Analytics. VHist ETL overview. **Hands on Sessions:** Installation of Talend / Pentahoetl tools, Importing source files from Data Warehouse and modification of data to target storage. Application of Map operation, Concept of Meta data. | | |
| 4 | **Vertica Database Administration:**<br>Introduction to HP-Vertica Database. Installation of HP vertica on Linux platform, Creation of Databases, Managing users, groups. Creation of tables and executing SQL statements. Working with VerticaManagement Console. Hands on Projections, nodes and creation of Cluster in vertica environment for databases with K-safety concept.Administration towards HP-Vertica database.<br>**Hands on Sessions:** Installation of vertica on Linux Platform, creation of database, executing SQL statements, creating management console, creating vertica cluster. | 09 | CO4 |
| 5 | **Big Data Analytics:**<br>Big data overview, Introduction to Hadoop, Big data related to Hadoop, Installation of Hadoop step by step, Hadoop Distribution File Systems[HDFS] overview and operations, Map reduce Operations, Multi node clustering in Hadoop. Setting up linux using SSH, with creation of user and SSH setup with key generation. Java Installation.<br>**Installation of Hadoop:** With three optional modes of installation,<br>1. Local/standard mode. 2. Pseudo distributed mode. 3. Fully distributed mode.<br>Verifying Hadoop installation:<br>Name Node setup.<br>Verifying hadoopdfs.<br>Verifying yarn scripts.<br>Accessing Hadoop on browser.<br>Verifying all Applications for cluster | 09 | CO5 |

**Text Books:**

1. The Data Warehouse Lifecycle Toolkit Second Edition, by Ralph Kimball, Margy Ross, Warren Thornthwaite, Joy Mundy and Bob Becker, 2008. ISBN: 978-0-470-14977-5.

**References:**

1. Kimball Group"s site: http://www.kimballgroup.com/html/designtips.html
   2.SQL Server 2012 Product Documentation:
2. http://technet.microsoft.com/en/library/bb418433(v=sql.10).aspx
   3.Business Intelligence for SQL Server 2012: http://msdn.microsoft.com/enus/library/ee229548(v=sql.10).aspx

**EVALUATION**

**CIE - Continuous Internal Evaluation (50 Marks)**

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

**SEE – Semester End Examination (50 Marks)**

| Bloom's Taxonomy | % |
|---|---|
| Remember | 0 |
| Understand | 5 |
| Apply | 30 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

# APPENDIX A

## Outcome Based Education

**Outcome-based education** (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accredition:

**Program Educational Objectives:**  The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

**Program Outcomes:**  What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

**Course Outcome:**  The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

## Mapping of Outcomes

**COURSE OUTCOME**
↓
**PROGGRAM OUTCOME**
↓
**PROGRAM EDUCATIONAL OBJECTIVES**
↓
**DEPARTMENTAL MISSION**
↓
**DEPARTMENTAL VISION**
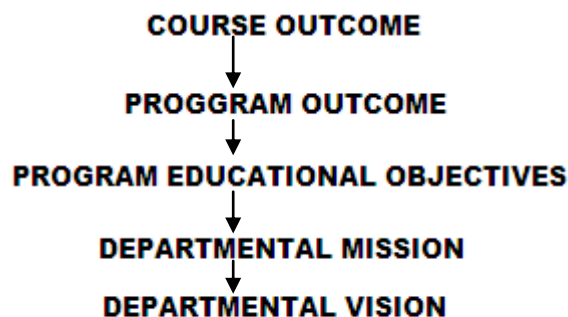
# APPENDIX B

## The Graduate Attributes of NBA

**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals,

and an engineering specialisation to the solution of complex engineering problems.

**Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**Conduct investigations of complex problems**: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**Life-long learning**: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

# APPENDIX C

# BLOOM'S TAXONOMY

**Bloom's taxonomy** is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student

learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. **[eduglosarry.org]**
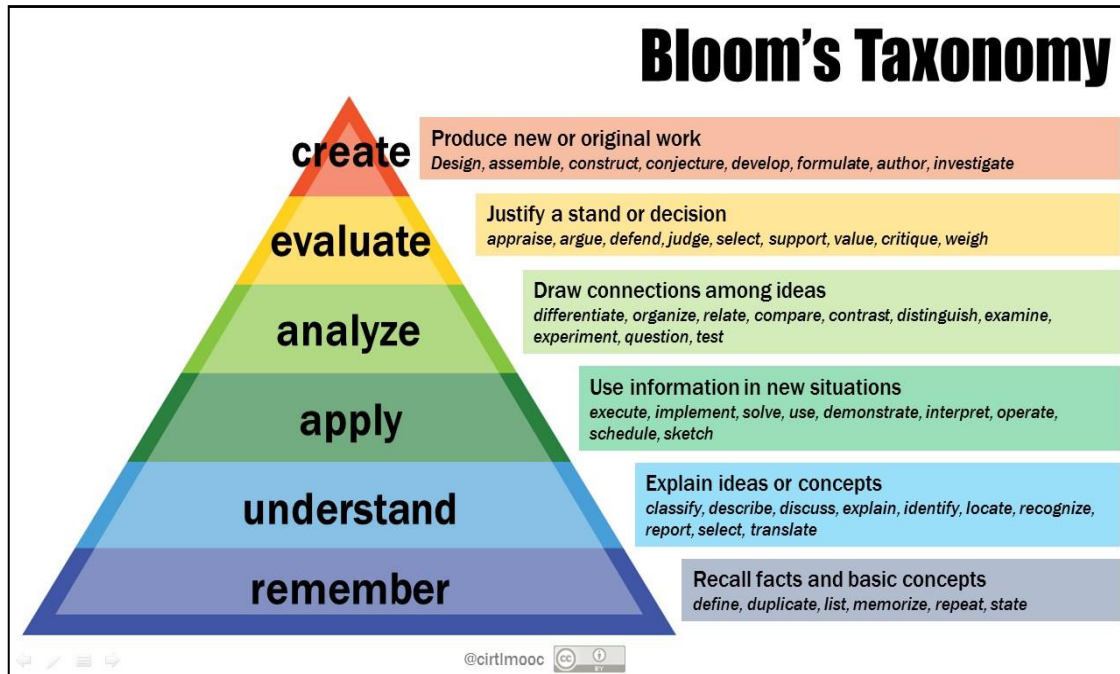
## SCHEME OF EIGHT SEMESTER

| Sl.No. | Course Code | Course | Subject Area | Credit Distribution | | | | Overall Credits | Contact Hrs Weekly Theory | Contact Hrs Weekly Lab | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | P | T | S | | | | CIE | SEE | Total |
| 1. | AUT81* | Professional Elective -V | PE | 3 | 0 | 0 | 1 | 4 | 4 | 0 | 50 | 50 | 100 |
| 2. | AUT82* | Professional Elective -VI | PE | 3 | 0 | 0 | 1 | 4 | 4 | 0 | 50 | 50 | 100 |
| 3. | AUT83 | Internship | INT | - | | | | 4 | 0 | 0 | 50 | 50 | 100 |
| 4. | AUT84 | Project Work | PRJ | - | | | | 10 | 0 | 0 | 150 | 150 | 300 |
| | Total | | | 6 | 0 | 0 | 2 | 22 | 8 | 0 | 300 | 300 | 600 |

| Professional Elective - V (AUT81*) | |
|---|---|
| Course | Course |
| AUT811 | Vehicle Body Engineering and Safety |
| AUT812 | Hybrid and Electric Vehicles |
| AUT813 | Heat and Mass Transfer |
| AUT814 | Automotive Materials and Component Testing |
| AUT815 | Two and Three Wheeled Vehicles |

| Professional Elective - VI (AUT82*) | |
|---|---|
| Course | Course |
| AUT821 | Non Destructive Testing |
| AUT822 | Engine Management System |
| AUT823 | Smart Materials |
| AUT824 | Maintenance Engineering |
| AUT825 | Engineering System Design |

# VEHICLE BODY ENGINEERING AND SAFETY

| | | | |
|---|---|---|---|
| **Course Code** | :AUT811 | **Credits** | :04 |
| **L:P:T:S** | :3:0:0:1 | **CIE Marks** | :50 |
| **Exam Hours** | :3 Hours | **SEE Marks** | :50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| AUT811.1 | Explain the different types of construction of vehicle body of cars, buses, commercial vehicles. |
| AUT811.2 | Describe the various materials used for the construction of vehicle bodies. |
| AUT811.3 | Analyse the various forces and moments acting on the vehicle body. |
| AUT811.4 | Discuss the interior ergonomics of various vehicle body types. |
| AUT811.5 | Describe the driver's visibility, methods of improving visibility and various seating dimensions. |
| AUT811.6 | Understand the safety features to be included during the construction of vehicle. |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUT811.1** | 3 | - | 1 | - | - | 2 | 1 | - | - | 3 | - | 1 |
| **AUT811.2** | 3 | - | - | - | - | 1 | 2 | - | - | 1 | - | 1 |
| **AUT811.3** | 3 | 2 | 1 | - | 1 | 2 | 2 | 3 | 1 | 2 | - | 1 |
| **AUT811.4** | 3 | 2 | 2 | - | - | 3 | 1 | - | 1 | 2 | - | 1 |
| **AUT811.5** | 3 | - | 1 | - | - | 1 | 1 | 3 | 1 | 1 | - | 1 |
| **AUT811.6** | 3 | - | 2 | - | - | 2 | 3 | 3 | 2 | 3 | - | 1 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1. | **Introduction:** 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. | 09 | AUT811.1 |
| 2. | **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. | 09 | AUT811.2 |
| 3. | **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. | 09 | AUT811.3 |
| 4. | **Interior Ergonomics**: Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, 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. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms. | 09 | AUT811.4 AUT811.5 |
| 5. | **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. | 09 | AUT811.6 |

*Self-Study: Case study on various commercial vehicle driver's cabin design and ergonomics*

**Text Books:**

1. Sydney F page, "Body Engineering"' Chapman & Hall Ltd, London, 1956

2. "Giles J Pawlowski", Vehicle body engineering Business books limited, 1989
3. John Fenton, "Vehicle body layout and analysis", Mechanical Engg. Publication ltd, London.


**Reference Books:**

1. Hand book on vehicle body design – SAE publication
2. Automotive chassis by P.M. Heldt, Chilton & Co, 1970
3. Vehicle Safety 2002, Cornwell press, Townbridge, UK, ISBN 1356 -1448.
4. Redesign of bus bodies – part I & part II – CIRT pune (Report), 1983
5. Ed W.H. Hucho, Aerodynamics of Road Vehicles, 4th Edition, Butter worth's 1987
6. Scibor-Rylski A.J, Road Vehicle Aerodynamics, Pentech press, London 2nd Edition 1984
7. Rae W.H & Pope A, Low Speed Wind Tunnel Testing Wiley & Sons, USA 1984 out of print

**MOOCs:**
1. https://www.mooc-list.com/course/vehicle-dynamics-iii-vertical-oscillations-iversity
2. https://www.mooc-list.com/course/vehicle-dynamics-ii-cornering-iversity

**Assessment Pattern:**


**CIE- Continuous Internal Evaluation for theory (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| Marks ( Out of 50) | 25 | 10 | 05 | 10 |
| Remember | 05 | | 01 | |
| Understand | 10 | 05 | 03 | |
| Apply | 05 | | | |
| Analyze | 05 | 05 | 01 | 10 |
| Evaluate | | | | |
| Create | | | | |


**SEE – Semester End Examination**

**(50 Marks – Theory)**

| Bloom's Category | SEE (Theory) |
|---|---|
| Remember | 10 |
| Understand | 20 |
| Apply | 10 |
| Analyse | 10 |
| Evaluate | |

| Create | |
|--------|--|
| | |

**HYBRID AND ELECTRIC VEHICLES**

**Course Code** :AUT812                                    **Credits** :4

**L:P:T:S** :3:0:0:1                                        **CIE Marks** :50

**Exam Hours** :3                                           **SEE Marks** :50

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT812.1 | Understand Basic of hybrid and electric vehicles |
|----------|--------------------------------------------------|
| AUT812.2 | Explain Different energy storage devices |
| AUT812.3 | Describe different Characteristics of Fuel Cells |
| AUT812.4 | Analyse the Performance of electric vehicles |
| AUT812.5 | Understand Concepts of hybrid electric drive train |
| AUT812.6 | Classify Electric motors and controllers |

**Mapping of Course Outcomes to Program Outcomes:**

|          | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| AUT812.1 | 3 | 1 | - | - | - | 1 | 3 | - | 1 | 3 | 3 | 1 |
| AUT812.2 | 3 | 2 | 1 | - | 2 | 1 | 1 | 3 | 2 | 2 | 3 | 1 |
| AUT812.3 | 3 | 2 | 2 | 2 | - | 3 | 1 | - | 2 | 1 | - | 1 |
| AUT812.4 | 3 | 1 | 1 | 2 | 2 | - | 2 | 3 | 2 | 2 | 3 | 1 |
| AUT812.5 | 3 | 1 | 1 | - | - | 2 | - | - | 1 | 3 | - | 1 |
| AUT812.6 | 3 | 1 | - | - | - | 3 | 3 | - | 3 | 3 | - | 2 |

| Module No. | Module Contents | Hours | Co's |
|---|---|---|---|
| 1 | **INTRODUCTION TO NEED FOR ALTERNATIVE SYSTEM**<br><br>History of electric and hybrid vehicles. Need of electric and hybrid vehicles – comparative study of diesel, petrol, electric and hybrid vehicles. Limitations of electric vehicles. Specification of different electric and hybrid vehicles | 9 | AUT812.1 |
| 2 | **ENERGY STORAGE DEVICES AND FUELL CELLS**<br><br>Electromechanical batteries- types of batteries –lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency and ultra-capacitors.<br><br>Fuel Cell- Fuel cell characteristics- Fuel cell types-Hydrogen fuel cell- Connecting cell in series- water management in the PEM fuel cell- Thermal Management of the PEM fuel cell | 9 | AUT812.2,<br><br>AUT812.3 |
| 3. | **ELECTRIC VEHICLES**<br><br>Electric vehicle layout, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system, safety and challenges in electric vehicles. | 9 | AUT812.4 |
| 4. | **HYBRID VEHICLES**<br><br>Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, hybrid electric drive train design, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles. | 9 | AUT812.5 |
| 5. | **PROPULSION MOTORS AND CONTROLLERS**<br><br>Types of electric motors – working principle of AC and DC motors. Characteristic of shunt, series and compound type of DC motors- permanent magnet and separately exited DC motors. AC single phase and 3-phase motor – inverters – DC and AC motor speed controllers | 9 | AUT812.6 |

**Self Study: Recent development in fuel cells.**

**Text Books:**

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons,2003
2. Iqbal Husain, " Electric and Hybrid Vehicles-Design Fundamentals", CRC Press,2003
3. MehrdadEhsani,


**REFERENCE BOOKS:**

1. Ron HodKinson, " light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication,2005
2. Lino Guzzella, " Vehicle Propulsion System" Springer Publications,2005

**Assessment Pattern:**

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self -Study |
|---|---|---|---|---|
| Marks ( out of 50) | **25** | **10** | **05** | **10** |
| Remember | 05 | | 02 | |
| Understand | 05 | 05 | 03 | |
| Apply | 05 | 05 | | 05 |
| Analyze | 05 | | | 05 |
| Evaluate | 05 | | | |
| Create | | | | |

### SEE – Semester End Examination

### (50 Marks – Theory)

| Bloom's Category | Tests (Theory) |
|---|---|
| Remember | 10 |
| Understand | 15 |
| Apply | 10 |
| Analyze | 10 |
| Evaluate | 05 |
| Create | |

**HEAT AND MASS TRANSFER**

| | | |
|---|---|---|
| **Course Code** :AUT813 | **Credits** | :04 |
| **L:P:T:S** :3:0:0:1 | **CIE Marks** | :50 |
| **Exam Hours** :03 | **SEE Marks** | :50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT813.1 | Classify different modes of Heat transfer |
|---|---|
| AUT813.2 | Understand the concept of steady state and unsteady state conduction |
| AUT813.3 | Apply concept of boundary layer theory and convection for solving problems |
| AUT813.4 | Analyse the performance of Heat exchangers based on different methods. |
| AUT813.5 | Explain the concept of boiling and condensation. |
| AUT813.6 | Understand the basic concepts of radiation heat transfer which included both black body radiation and grey body radiation |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUT813.1** | 3 | 3 | 3 | - | - | - | 1 | - | - | 3 | - | 2 |
| **AUT813.2** | 3 | 3 | 2 | - | - | - | 1 | - | - | 3 | - | 2 |
| **AUT813.3** | 3 | 3 | 1 | 2 | - | - | 1 | - | - | 2 | - | - |
| **AUT813.4** | 3 | 3 | 2 | 2 | - | - | 1 | - | - | 3 | - | 2 |
| **AUT813.5** | 3 | 3 | 3 | 2 | - | - | 1 | - | - | 3 | - | - |
| **AUT813.6** | 3 | 3 | 3 | 2 | - | - | 1 | - | - | 2 | - | 2 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **Introductory Concepts:** Modes of Heat Transfer-Laws governing modes of Heat Transfer, Thermal conductivity, General heat conduction equation-Cartesian (Derivation),cylindrical and spherical co-ordinates (No derivation), One dimensional steady state heat conduction in simple geometries ,plane wall, cylinder and sphere , Heat transfer composite walls - composite cylinders and composite spheres ,Critical thickness of insulation ,Thermal contact resistance, Overall heat transfer coefficient ,Electrical analogy ,Heat generation in plane wall ,cylinder and sphere. | 09 | AUT813.1 |
| 2 | **Extended Surfaces or Fins:** Classification, Straight Rectangular and Circular Fins, Temperature Distribution and Heat Transfer Calculations, Fin Efficiency and Effectiveness, Applications<br><br>**Transient [Unsteady-state] heat conduction**: Definition, Different cases - Negligible internal thermal resistance, negligible surface resistance, Lumped body, Infinite Body and Semi-infinite Body, Numerical Problems, Heisler charts | 09 | AUT813.2 |
| 3. | **Forced Convection:** Boundary Layer Theory, Velocity and Thermal Boundary Layers, Prandtl number, Boundary layer assumptions, Integral and Analytical solutions to above equations, Turbulent flow, Various empirical solutions, Forced convection flow over cylinders and spheres, Internal flows –laminar and turbulent flow solutions<br><br>**Free convection**: Laminar and Turbulent flows, Vertical Plates, Vertical Tubes and Horizontal Tubes, Empirical solutions. | 09 | AUT813.3 |
| 4. | **Condensation and Boiling:** Types of condensation (discussion only), Use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks, Reynolds number for condensate flow; regimes of pool boiling pool boiling correlations. Numerical problems.<br><br>**Heat Exchangers**: Definition, Classification, applications, LMTD method, Effectiveness - NTU method, Analytical Methods, Fouling Factors, Chart Solution Procedures for solving Heat Exchanger problems: Correction Factor Charts and Effectiveness-NTU Charts | 09 | AUT813.4, AUT813.5 |
| 5. | **Thermal Radiation;** definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel Infinite black surfaces, between two parallel Infinite gray | 09 | AUT813.6 |

| | surfaces, Effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces, Configuration factor or view factor. Numerical problems | | |
|---|---|---|---|

**Self Study:** Experimental Study on Determination of heat transfer Coefficient using Convection.

**Text Books:**
1.  Heat and Mass transfer, P.K. Nag, Tata McGraw Hill Pub 2011 3rd Edition, **ISBN:** 9780070702530
2. Heat transfer, a practical approach, Yunus A- Cengel Tata McGraw Hill, 5th Ed, **ISBN:** 9789339223199

**REFERENCE BOOKS:**
1. Heat transfer-A basic approach, Ozisik, Tata McGraw Hill 2002
2. Heat Transfer, Holman, J. P., 9th Edition, Tata McGraw Hill, New York, 2008
3. Fundamentals of Heat and Mass Transfer, Incropera, F. P. and De Witt, D. P., 5th Edition, John Wiley and Sons, New York, 2006.
4. Heat and Mass Transfer by Tirumaleswar, Pearson education 2006.

**Assessment Pattern:     CIE- Continuous Internal Evaluation for theory (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| Marks ( out of 50) | **25** | **10** | **05** | **10** |
| Remember | | | 01 | |
| Understand | 05 | | 01 | |
| Apply | 10 | 05 | 01 | 05 |
| Analyze | 10 | 05 | 01 | 05 |
| Evaluate | 05 | | 01 | |
| Create | | | | |

**SEE – Semester End Examination**

**(50 Marks – Theory)**

| Bloom's Category | Tests (Theory) |
|---|---|
| Remember | |
| Understand | 10 |
| Apply | 10 |
| Analyse | 15 |
| Evaluate | 15 |

| Create | |
|--------|--|

## AUTOMOTIVE MATERIALS AND COMPONENT TESTING

**Course Code** : AUT814                               **Credits** :04

**L:P:T:S** : 3:0:0:1                                   **CIE Marks** :50

**Exam Hours** : 03                                     **SEE Marks** :50

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT814.1 | Discuss different materials used for automotive component manufacturing. |
|----------|-------------------------------------------------------------------------|
| AUT814.2 | Select proper material for Automobile applications |
| AUT814.3 | Understand the materials for transmission, structures, electronic materials |
| AUT814.4 | apply their knowledge in using all kind of sensors, actuators and instruments used in automobile testing |
| AUT814.5 | apply their knowledge in conducting different types of experiments in automobiles |
| AUT814.6 | Apply their knowledge for engine test and endurance test |

**Mapping of Course Outcomes to Program Outcomes:**

|          | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| AUT814.1 | 3 | 3 | 2 | - | - | 2 | 3 | - | - | 1 | - | 1 |
| AUT814.2 | 3 | 3 | 2 | - | - | 2 | 3 | - | 2 | 1 | - | 1 |
| AUT814.3 | 3 | 3 | 3 | - | - | 1 | 2 | - | 2 | 1 | - | 1 |
| AUT814.4 | 3 | 3 | 3 | - | 2 | 2 | 2 | - | - | 1 | - | 1 |
| AUT814.5 | 3 | 3 | 3 | - | 2 | 1 | 3 | - | - | 1 | - | 1 |
| AUT814.6 | 3 | 3 | - | 1 | 2 | 3 | 1 | - | - | 1 | - | 1 |

| Module No. | Module Contents | Hours | Co's |
|---|---|---|---|
| 1 | **ENGINEERING MATERIALS AND THEIR PROPERTIES** Classes of engineering materials - the evolution of engineering materials, Definition of materials properties, Displaying material properties using materials selection charts, Forces for change in materials selection and design, Materials and the environment-selection of materials for automotive, aerospace, marine and defence applications. | 09 | AUT814. 1 |
| 2 | **BASIS OF MATERIAL SELECTION:** Selection strategy, Attribute limits and Material indices, structural index Selection procedure: Design process - types of design, design requirements, Function, Material attributes, Shape and Manufacturing processes - Materials processing and design processes and their influence on design, Process attributes, Systematic process selection, Process selection diagrams, Process cost, Energy consumption for production, Material costs, Availability, Recyclability, Environmental consideration. Computer aided selection. | 09 | AUT814. 2 |
| 3 | **MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS** Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches. MATERIALS FOR AUTOMOTIVE STRUCTURES Materials selection for bearings, leaf springs, chasis& frames, Bumper, shock absorbers, wind screens, panels, brake shoes, Disc, wheels, differentials , damping and antifriction fluids, Tyres and tubes. ELECTRONIC MATERIALS FOR AUTOMOTIVE APPLICATIONS Materials for electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, anti-collision, Anti-fog, Head lamps. | 09 | AUT814. 3 |
| 4 | **MEASUREMENT SYSTEMS** Introduction to Measurement systems-static and dynamic measurement –closed and open loop system - Requirements and characteristics – Analysis of experimental detail. Error analysis TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES Transducers for Automotive Applications – Amplifiers- filters – data Acquisition- Indicators, Printers and displays –Signal | 09 | AUT814. 4 |

| | | | | |
|---|---|---|---|---|
| | Analyzing. | | | |
| 5 | **MECHANICAL MEASUREMENT** Instrumentation for measuring Weight, Force, torque, pressure power, temperature, fluid flow, vibration, rotational speed, velocity, acceleration and angular motion.<br><br>**ENGINE EXPERIMENTAL TECHNIQUES** I.S Code for Engine testing – Instrumentation for performance testing of engine, Instrumentation for Research and development, Instrumentation for noise, vibration, in cylinder gas flow, flame temperature, Dynamic Cylinder pressure measurements.<br><br>**VEHICLE EXPERIMENTAL TECHNIQUES** Laboratory tests- Study of chassis dynamometer- test tracks - Endurance Tests- crash tests- Vehicle performance test – Brake tests. | 09 | AUT814. 5, AUT814. 6 |

*Self Study: Automotive Materials And Its Properties.*

**Text Books:**
1. Lewis, "Selection of Engineering Materials", Prentice Hall Inc. New Jersey USA, 1995.
2. Charles J A and Crane. F A. A., "Selection and Use of Engineering Materials", 3rd Edition, Butterworths, London UK, 1996.
3. Ernest O. Doebelin. Measurement systems: application and design. McGraw Hill Publishing Co, 2004, ISBN 0–07–243886–X.
4. NicosLadommatos and Hua Zhao, Engine Combustion Instrumentation and Diagnostics. SAE International, 2001-01-30, ISBN of 978-0-7680-0665-0.

**REFERENCE BOOKS:**
1. James A. Jacobs, Thomas F. Kilduff., "Engineering Materials Technology: Structure, Processing, Properties & Selection", Prentice Hall, USA, 1996.
2. ASM Handbook, "Selection of Materials Vol. 1 and 2", ASM Metals Park, Ohio. USA, 1991.
3. M F Ashby, "Materials Selection in Mechanical Design", third edition, Butterworth-Heineman, New York, 2005.
4. ASM Handbook. "Materials Selection and Design", Vol. 20- ASM Metals Park Ohio.USA, 1997.
5. Cantor," Automotive Engineering: Lightweight, Functional, and Novel Materials", Taylor & Francis Group, London, 2006
6. A.W. Judge, Engineering Precision Measurement, Chapman and Hall Ltd, Essex Street W.C.,1951, 7. T.G. Beckwith and Buck, Mechanical Measurements, Oxford and IBH Publishing House, New Delhi, 1995

8. D.Patambis, Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co, New Delhi, 1990.

9. Rangan, Sharma and Mani, Instrumentation Devices and systems, Tata McGraw Hill Publishing Co., Ltd., 1990

10. J.G. Giles, Engine and Vehicle Testing, Wildlife books Ltd., London, 1968.

**Assessment Pattern:**

**CIE- Continuous Internal Evaluation for theory (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self Study |
|---|---|---|---|---|
| Marks ( out of 50) | 25 | 10 | 5 | 10 |
| Remember | 10 | | | |
| Understand | 15 | 5 | 5 | |
| Apply | 10 | 5 | | 5 |
| Analyze | 10 | | | 5 |
| Evaluate | | | | |
| Create | | | | |

**SEE – Semester End Examination**

**(50 Marks – Theory)**

| Bloom's Category | Tests (Theory) |
|---|---|
| Remember | 10 |
| Understand | 20 |
| Apply | 10 |
| Analyze | 10 |
| Evaluate | |
| Create | |

# TWO AND THREE WHEELED VEHICLES

| Course Code | :AUT815 | | Credits | :4 |
|---|---|---|---|---|
| L:P:T:S | :3:0:0:1 | | CIE Marks | :50 |
| Exam Hours | : 3 | | SEE Marks | :50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT 815.1 | Classify two wheelers and three wheelers and their layout |
|---|---|
| AUT 815.2 | Understand the different types of chassis, frames and ergonomic considerations for the body of the car. |
| AUT 815.3 | Compare the power plant, lubrication, cooling system etc of two wheelers and three wheelers. |
| AUT 815.4 | Compare the clutches, gears, final drive, differential and steering of two wheelers and three wheelers. |
| AUT 815.5 | Understand the basics of braking system and suspension system of two and three wheelers |
| AUT 815.6 | Describe about the performance and maintenance of two and three wheelers. |

**Mapping of Course Outcomes to Program Outcomes:**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT 815.1 | 3 | - | | - | - | - | | - | - | 3 | - | 3 |
| AUT 815.2 | 3 | 3 | 1 | 2 | - | - | 3 | 1 | 2 | 3 | - | 3 |
| AUT 815.3 | 3 | 3 | 1 | 2 | - | - | 2 | - | 2 | 3 | - | 3 |
| AUT 815.4 | 3 | 3 | 1 | 2 | - | 2 | 3 | - | 2 | 1 | - | 3 |
| AUT 815.5 | 3 | 3 | 1 | - | - | 2 | 2 | - | - | 2 | 1 | 3 |
| AUT 815.6 | 3 | 3 | 1 | - | 1 | 2 | 3 | 1 | - | 3 | 1 | 3 |

| Module No. | Module Contents | Hours | Cos |
|---|---|---|---|
| 1 | **Introduction**: Development, Classification & layouts of two wheelers (motorcycles, scooters, mopeds) and Three wheelers, applications & capacity – goods & passengers, study of technical specification of Two & Three wheelers. Frames & Body: Types of frame, construction, loads, design consideration, materials, Types of three wheeler bodies, layout, RTO regulations, aerodynamic, aesthetic & ergonomics | 9 | **AUT 815.1, AUT 815.2** |
| 2 | **The Power unit:** Selection of engine for two wheeler & three wheeler, Design considerations for two wheeler & three wheeler power plants, special systems requirements for lubrication, cooling, starting. Recent engine developments. | 9 | **AUT 815.3** |
| 3. | **Transmission and steering system:** Transmission Systems : Clutch – special requirements, different types used in two & three wheelers, need of primary reduction, selection of transmission - gear transmission, gear shift mechanism, belt transmission, automatic transmission final drive & differential for three wheeler, wheel drive arrangement. Steering : Steering geometry, steering column construction, steering system for three wheelers | 9 | **AUT 815.4** |
| 4. | **Brake and suspension system:** Brake, Wheel & Tyres: Design consideration of brake, types of brakes – disc, drum, braking mechanism – mechanical, hydraulic & servo, wheel types - spokes, disc, split, special tyre requirements for two & three wheelers. Suspension requirements, design considerations, trailing & leading link, swinging arm, springs & shock | 9 | **AUT 815.5** |
| 5. | **Performance and maintenance: Road Performance**: Handling characteristics, driver & pillion seating arrangement, ergonomics & comfort, road holding & vehicle stability, riding characteristics, safety arrangements, Racing bikes – special requirements. Maintenance: Preventive & brake down maintenance, factors affecting fuel economy & emission. | 9 | **AUT 815.6** |

*Self Study: Engine management system in two and three wheeled vehicles.*

**Text books:**

**1.**Dhruv.U.Panchal, "Two and Three wheeler technology",PHI publishers,2015:ISBN13: 978-81-7317-792-7.

**2**. Gaetano Cocco, "Motorcycle Design and Technology", Giorgio Nada Editor (April 1, 2013)

**Reference books**

1. Mick Walker, "Motorcycle: Evolution, design and Passion", Johns Hopkins, 2006
2. Marshall Cavensih, "Encyclopaedia of Motor cycling, 20 volumes", New York and London, 1989
3. John Robinson, "Motorcycle Tuning: Chassis", Butterworth-Heinemann, 2001
4. Service Manuals of Manufacturers of Indian Two & Three wheelers.

**MOOCs:**
1. https://www.youtube.com/watch?v=qxNTQozl5fE
2. Continuous Variable transmission-https://www.youtube.com/watch?v=oGHE3QL9ABo

**Assessment Pattern:**

**CIE- Continuous Internal Evaluation for theory (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self Study |
|---|---|---|---|---|
| Marks ( out of 50) | 25 | 10 | 5 | 10 |
| Remember | 10 | | - | - |
| Understand | 10 | | - | - |
| Apply | | 5 | 5 | 5 |
| Analyze | | 5 | - | 5 |
| Evaluate | 5 | | - | |
| Create | | | - | |

**SEE – Semester End Examination   (50 Marks – Theory)**

| Bloom's Category | Tests (Theory) |
|---|---|
| Remember | 20 |
| Understand | 20 |
| Apply | 5 |
| Analyze | |
| Evaluate | 5 |
| Create | |

## Non Destructive Testing

| | | | |
|---|---|---|---|
| **Course Code** | :AUT821 | **Credits** | :04 |
| **L:P:T:S** | :3:0:0:1 | **CIE Marks** | :50 |
| **Exam Hours** | :03 | **SEE Marks** | :50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT821.1 | Describe various NDT techniques, equipment, applications and limitations |
|---|---|
| AUT821.2 | Understand Magnetic particle Inspection |
| AUT821.3 | Selection, application of appropriate NDT method for various components using NDT standards and interpretation of defects |
| AUT821.4 | Explain Eddy Current Inspection  principles |
| AUT821.5 | Explain radiography principle |
| AUT821.6 | Analyse various limitations of Holography |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUT821.1** | 3 | 3 | 2 | 2 | 3 | 1 | - | - | 1 | - | - | 2 |
| **AUT821.2** | 3 | 3 | 2 | 2 | 3 | 1 | - | - | 1 | - | - | 2 |
| **AUT821.3** | 3 | 3 | 2 | 1 | 3 | 1 | - | - | 1 | - | - | 2 |
| **AUT821.4** | 3 | 3 | 2 | 1 | 3 | 1 | - | - | 1 | - | - | 2 |
| **AUT821.5** | 3 | 3 | 2 | 1 | 3 | 1 | - | - | 1 | - | - | 2 |
| **AUT821.6** | 3 | 3 | 2 | 2 | 3 | 1 | - | - | 1 | - | - | 2 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **Introduction to ND Testing**: Selection of ND methods, visual inspection (Boroscopes, Image sensors, Magnifying Systems) leak testing: Method of leak testing systems at pressure or at vacuum, liquid penetration inspection, its advantages and limitation.<br><br>**Magnetic Particle Inspection**: Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection – application and limitations | 09 | AUT821.1, AUT821.2 |
| 2 | **Ultrasonic inspection**: Basic equipment, advantages and disadvantages, applicability, characteristics of ultrasonic waves, variables inspection, attenuation of ultrasonic beams, inspection methods:- pulse echo, A,B,C scans transmission. Transducer elements couplets, search units, contact types and immersion types, inspection standards-standard reference blocks, Indian standards for NDT. | 09 | AUT821.3 |
| 3. | **Eddy Current Inspection**: principles, operation variables, procedure, | 09 | AUT821. |

| | | | |
|---|---|---|---|
| | inspection coils, and detectable discounts by the method. | | **4** |
| **4.** | **Radiography Inspection**: principles, radiation source X-rays and gamma rays, X-ray-tube, radio graphic films, neutron radiography, Thermal inspection principles, equipment inspection methods applications | **09** | **AUT821. 5** |
| **5.** | **Optical Holography**: Basics of Holography, recording and reconstruction - Acoustical Holography: systems & techniques applications. Microwave holography: Technique, applications and limitations | **09** | **AUT821. 6** |

**SELF-STUDY:**
> ***Study the Present case studies with technical reports on current research in the relevant field***

**Text Books:**
1. Non Destructive Testing - Mc Gonnagle JJ – Garden and reach New York.

**Reference Books:**

1. Non Destructive Evolution and Quality Control - volume 17 of metals hand book 9 edition Asia internal 1989.
2. The Testing instruction of Engineering materials - Davis H.E Troxel G.E wiskovil C.T - McGraw hill.

E-BOOKS : 1.https://www.asnt.org/Store/ProductDetail?productKey=f3f52371-81eb-4cd3-b463-179a55ec36a5

**MOOCs:**

1. https://www.mooc-list.com/course/16101x-introduction-aerodynamics-edx
2. https://www.mooc-list.com/course/mae6226-aerodynamics-hydrodynamics-gw-online

**Assessment Pattern:**

**CIE- Continuous Internal Evaluation for theory (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| **Marks ( out of 50)** | **25** | **10** | **05** | **10** |
| Remember | 05 | | 03 | |
| Understand | 05 | | 02 | |
| Apply | 05 | 05 | | |
| Analyze | 05 | 05 | | 10 |
| Evaluate | 05 | | | |
| Create | | | | |

## SEE – Semester End Examination

## (50 Marks – Theory)

| Bloom's Category | SEE(Theory) |
|---|---|
| Remember | 10 |
| Understand | 10 |
| Apply | 15 |
| Analyze | 10 |
| Evaluate | 05 |
| Create | |

# Engine Management System

| Course Code | :AUT822 | Credits | :04 |
|---|---|---|---|
| L:P:T:S | :3:0:0:1 | CIE Marks | :50 |
| Exam Hours | :03 | SEE Marks | :50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| AUT822.1 | Explain standard Inline Diesel Injection System Electronic diesel injection |
|---|---|
| AUT822.2 | Clearly differentiate between IDI and Electronic diesel injection |
| AUT822.3 | Gain knowledge about Common Rail Direct Injection functions and components |
| AUT822.4 | Analyse Cylinder charge control systems |
| AUT822.5 | Understand the type of sensors, actuators used in engines for efficient fuel management |
| AUT822.6 | Know the major constituents of exhaust gas, means of reducing emissions |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT822.1 | 3 | 3 | - | 2 | 2 | - | - | 1 | 1 | 1 | 2 | 1 |
| AUT822.2 | 3 | 3 | - | 2 | 2 | - | - | 1 | 1 | 1 | 2 | 1 |
| AUT822.3 | 3 | 3 | - | 2 | 2 | - | - | 1 | 1 | 1 | 2 | 1 |
| AUT822.4 | 3 | 3 | - | 2 | 2 | - | - | 1 | 1 | 1 | 2 | 1 |
| AUT822.5 | 3 | 3 | - | 2 | 2 | - | - | 1 | 1 | 1 | 2 | 1 |
| AUT822.6 | 3 | 3 | - | 2 | 2 | - | - | 1 | 1 | 1 | 2 | 1 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **DIESEL FUEL INJECTION SYSTEM:** Overview of in-line Fuel injection pump systems, design, control PE standard in line FIP, design of pump and barrel assembly, stroke phases, delivery valve, RQ type of governors, types of nozzles. | 09 | AUT822.1 |
| 2 | **ELECTRONIC DIESEL CONTROL EDC:** Overview, data processing, data transmission to other systems, electronically controlled PE-EDC in line fuel injection pumps: system blocks, ECU, control loops, further functions, safety concepts, advantages. | 09 | AUT822.2 |
| 3. | **COMMON RAIL ACCUMULATOR FUEL – INJECTION SYSTEM:** System overview, functions, injection characteristics, exhaust gas reduction, fuel system, design and function of components: low pressure and high pressure stages, preheating systems. | 09 | AUT822.3 |

| 4. | **CYLINDER – CHARGE CONTROL SYSTEMS AND SENSORS** : Electronic Throttle Control, Variable valve timing, and dynamic supercharging. Sensors- Knock sensor, Pressure sensor, position sensor and oxygen sensor. | 09 | AUT822. 4, AUT822. 5, |
|---|---|---|---|
| 5. | **EXHAUST EMISSION**: Major constituents of exhaust gas, pollutants, Factors affecting raw emissions, emission reduction techniques, catalytic converter, NOx accumulator, lambda control loop, catalytic converter heating. | 09 | AUT822. 6 |

**SELF-STUDY:**

*Study System control using actuators, information exchange, integrated diagnosis, and lambda closed loop control for diesel.* .

**Text Books:**

1.Gasoline Engine Management- Robert Bosch GmbH, 3rd Edition, 2006, , John Wiley & sons.
2. Diesel-Engine Management-system & components Horst Bauer,   2nd Edition, 1999 Robert Bosch GmbH, SAE International

**Reference Books:**

1. Internal Combustion Engine- V.Ganesan, 2nd edition,, 2004, Tata McGraw Hill.
2. Internal Combustion Engine fundamentals - J.B. Heywood, 1988   McGraw-Hill
3. Diesel-Engine Management-system & components, Robert Bosch GmbH 4th   Edition, 2005 John Wiley & sons.

Assessment Pattern:

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| Marks ( out of 50) | 25 | 10 | 05 | 10 |
| Remember | 05 | | 03 | |
| Understand | 05 | | 02 | |
| Apply | 05 | 05 | | |
| Analyze | 05 | 05 | | 10 |
| Evaluate | 05 | | | |
| Create | | | | |

**SEE – Semester End Examination**

**(50 Marks – Theory)**

| Bloom's Category | SEE(Theory) |
|------------------|-------------|
| Remember         | 10          |
| Understand       | 10          |
| Apply            | 15          |
| Analyze          | 10          |
| Evaluate         | 05          |
| Create           |             |

# SMART MATERIALS

| | |
|---|---|
| **Course Code** :AUT823 | **Credits** :04 |
| **L:P:T:S** :3:0:0:1 | **CIE Marks** :50 |
| **Exam Hours** :03 | **SEE Marks** :50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| **AUT823.1** | Design and construct simple functional structures using smart materials engineering |
| **AUT823.2** | Apply the applications of Sensors |
| **AUT823.3** | Characterize interaction between smart materials and simple structures in actuation and sensing |
| **AUT823.4** | Explain optics and electromagnetic principles. |
| **AUT823.5** | Describe and characterize novel functions of smart materials using structure-property relationships Communication |
| **AUT823.6** | Present and demonstrate functions of smart structures |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUT823.1** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT823.2** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT823.3** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT823.4** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT823.5** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT823.6** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **INTRODUCTION:** Characteristics of composites and ceramics materials, Dynamics and controls, concepts, Electro-magnetic materials and shape memory alloys-processing and characteristics | 09 | AUT823.1 |
| 2 | **SENSING AND ACTUATION** Principals of electromagnetic, acoustics, chemical and mechanical sensing and actuation, Types of sensors and their applications, their compatibility writer conventional and advanced materials, signal processing, principals and characterization. | 09 | AUT823.2, AUT823.3 |
| 3. | **CONTROL DESIGN** Design of shape memory alloys, Types of MR fluids, Characteristics and application, principals of MR fluid value designs, Magnetic circuit design, MR Dumpers, Design issues. | 09 | AUT823.4 |

| | | | | |
|---|---|---|---|---|
| | **OPTICS AND ELECTROMAGNETIC** Principals of optical fiber technology, characteristics of active and adaptive optical system and components Design and manufacturing principles. | | | |
| 4. | **STRUCTURES** Principles of drag and turbulence control through smart skins, applications in environment such as aerospace and transportation vehicles, manufacturing, repair and maintainability aspects.<br><br>**CONTROLS** Principles of structural acoustic control, distributed, analog and digital feedback controls, Dimensional implications for structural control. | **09** | **AUT823.5,** |
| 5. | Principles of Vibration and Modal Analysis, PZT Actuators, MEMS, Magnetic shape Memory Alloys, Characteristics and Applications.<br><br>**INFORMATION PROCESSING** Neural Network, Data Visualization and Reliability – Principals and Application domains. | **09** | **AUT823.6** |

**SELF-STUDY:**
   *Study on Data processing*

**Text Books:**

1. Analysis and Design - A.V.Srinivasan, 'Smart Structures –Cambridge University Press, New York, 2001, (ISBN :0521650267)
2. Smart Materials and Structures - M V Gandhi and B S Thompson Chapmen & Hall, London, 1992 (ISBN : 0412370107)

**Reference Books:**

1. Smart Materials and Structures - Banks HT, RC Smith, Y Wang, Massow S A, Paris 1996

2. G P Gibss' Adaptive Structures - Clark R L, W R Saunolers, John Wiles and Sons, New York, 1998

3. An Introduction for Scientists and Engineers - Esic Udd, Optic Sensors : John Wiley & Sons, New York, 1991 (ISBN :0471830070)

**Assessment Pattern:**

**CIE- Continuous Internal Evaluation for theory (50 Marks)**

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| Marks ( out of 50) | 25 | 10 | 05 | 10 |
| Remember | 05 | | 03 | |
| Understand | 05 | | 02 | |
| Apply | 05 | 05 | | |
| Analyze | 05 | 05 | | 10 |
| Evaluate | 05 | | | |
| Create | | | | |

**SEE – Semester End Examination**

**(50 Marks – Theory)**

| Bloom's Category | SEE(Theory) |
|---|---|
| Remember | 10 |
| Understand | 10 |
| Apply | 15 |
| Analyze | 10 |
| Evaluate | 05 |
| Create | |

## MAINTENANCE ENGINEERING

| | | | |
|---|---|---|---|
| **Course Code** | :AUT824 | **Credits** | :04 |
| **L:P:T:S** | :3:0:0:1 | **CIE Marks** | :50 |
| **Exam Hours** | :03 | **SEE Marks** | :50 |

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| **AUT824.1** | Achieve a good understanding of the basic technologies as related to maintenance engineering, their scope and limitations |
| **AUT824.2** | Explain the maintenance strategies and the process of achieving them in various industry sectors |
| **AUT824.3** | Apply the principles of machinery measurements, and develop skills in processing signals and interpreting results |
| **AUT824.4** | Develop Maintenance planning by knowing their benefits. |
| **AUT824.5** | Analyse the safety needs in industries to prevent accidents |
| **AUT824.6** | Understand Industrial pollution |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUT824.1** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT824.2** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT824.3** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT824.4** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT824.5** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT824.6** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **Introduction to maintenance system:** Definition, Scope, Objective, Functions and importance of maintenance systems. Types of maintenance system, Break down maintenance, Preventive maintenance, Predictive maintenance. **DESIGN OUT MAINTENANCE:** Corrective maintenance, planned maintenance, Total Productive maintenance, Condition monitoring. Problems on selection methods like preventive or breakdown maintenance. | 09 | AUT824.1, AUT824.2, |
| 2 | **ECONOMICS IN MAINTENANCE:** Repair, replacement, repair complexity. Most optimal preventive maintenance frequency. Failures and losses. Types of failure and losses. Role of | 09 | AUT824.3 |

| | | | |
|---|---|---|---|
| | maintenance, bath tub curve, Numerical problems.<br><br>**MAINTENANCE OF MACHINERY**: Causes of machine failure, Performance evaluation, Complete overhauling of machine tools, Maintenance, Planning and scheduling. Repair order control manpower requirement, maintenance job analysis spare parts control. | | |
| 3. | **MAINTENANCE PLANNING**: Planning of maintenance junctures manpower allocation, long range planning, short range planning. Planning techniques and procedures. Estimation of maintenance work. Maintenance control.<br><br>**COMPUTERS IN MAINTENANCE**: Features and benefits of computer aided maintenance. Application of computers to maintenance work. | 09 | AUT824.4 |
| 4. | **INDUSTRIAL SAFETY**: Economic importance of accidents, importance of accident prevention, types of safety organizations, analysis of accident records, accident investigations, analysis of accident safety for mechanical equipment. Electrical equipment and systems. Chemical hazards, material handling, exhaust systems, housekeeping, passages, floors, tool cribs, wash rooms, canteens. | 09 | AUT824.5, |
| 5. | **INDUSTRIAL POLLUTION CONTROL:** Dust control – fibre collectors, mechanical dust collectors, wet type collectors, electro static precipitators, noise pollution control – noise measurement and control. Vibration and its control. | 09 | AUT824.6 |

**SELF-STUDY:**
    *Study on various Breakdown Schedules.*
**Text Books:**

1. Tarachand, Engineering economy
2. T.R.Banga & S.C.Sharma "Industrial Organisation and Engineering Economics"

**Reference Books:**
1. I.M Panday , Financial Management , Vikas Publishing House
2. Riggs J.L., Engineering economy, McGraw Hill, 2002
3. Engineering Economy by THUWSEN H.G, PHI, 2002
4. D.Kannappan Mechanical Estimation & Costing

**Assessment Pattern:**

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| **Marks ( out of 50)** | **25** | **10** | **05** | **10** |
| Remember | 05 | | 03 | |
| Understand | 05 | | 02 | |
| Apply | 05 | 05 | | |
| Analyze | 05 | 05 | | 10 |
| Evaluate | 05 | | | |
| Create | | | | |

### SEE – Semester End Examination

### (50 Marks – Theory)

| Bloom's Category | SEE(Theory) |
|---|---|
| Remember | 10 |
| Understand | 10 |
| Apply | 15 |
| Analyze | 10 |
| Evaluate | 05 |
| Create | |

# ENGINEERING SYSTEM DESIGN

| | | | |
|---|---|---|---|
| **Course Code** | **:AUT825** | **Credits** | **:04** |
| **L:P:T:S** | **:3:0:0:1** | **CIE Marks** | **:50** |
| **Exam Hours** | **:03** | **SEE Marks** | **:50** |

**Course Outcomes: At the end of the Course, the student will be able to:**

| | |
|---|---|
| **AUT825.1** | Develop an understanding of the Systems Engineering Process and the range of factors that influence the design, planning, production, evaluation and use of a system |
| **AUT825.2** | Understand the concepts of and develop skills in the design, construction, fault-finding, diagnosis, performance analysis, maintenance, modification, and control of technological systems |
| **AUT825.3** | Acquire knowledge of new developments and innovations in technological systems |
| **AUT825.4** | Develop an understanding of how technologies have transformed people's lives and can be used to solve challenges associated with climate change, efficient energy use, security, health, education and transport |
| **AUT825.5** | Gain an awareness of quality and standards, including systems reliability, safety and fitness for the intended purpose |
| **AUT825.6** | Understand Man-Machine Interaction |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AUT825.1** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT825.2** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT825.3** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT825.4** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT825.5** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| **AUT825.6** | 3 | 3 | - | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |

| Module No. | Module Contents | Hours | COs |
|---|---|---|---|
| 1 | **INTRODUCTION:** What is designing?, Man as a designer: Design by evolution, inadequacies of traditional design method: System approach of engineering problems: Need models: design history of large scale existing system**.**<br><br>**MORPHOLOGY OF DESIGN:** The three phases of design projects, the structure of design process, decision making and iteration**.** | 09 | **AUT825.1, AUT825.2,** |
| 2 | **IDENTIFICATION AND ANALYSIS OF NEED**: Preliminary need statement, analysis of need, specifications, and standards of performance and constrains | 09 | **AUT825.3** |

| | **ORIGINATION OF DESIGN CONCEPT**: Process of idealization, mental fixity, and some design methods like morphological analysis, AIDA, brainstorming etc. | | |
|---|---|---|---|
| 3. | **PRELIMINARY DESIGN:** Mathematical modelling for functional design: concept of sensitivity, compatibility and stability analysis.<br><br>**EVALUATION OF ALTERNATIVES AND DESIGN DECISIONS**: Physical reliability, DESIGN TREE: Quality of design, Concept of utility, multi criteria decisions, decisions under uncertainty and risk (Numerical) | 09 | AUT825.4 |
| 4. | **ECONOMICS AND OPTIMIZATION IN ENGINEERING DESIGN**: Economics in Engineering Design, Fixed and variable costs, break-even analysis. (Numerical) OPTIMIZATION: Introduction to LPP. | 09 | AUT825.5, |
| 5. | **MAN-MACHINE INTERACTION**: Designing for use and maintenance, Man-Machine Cycle, Design of displays and controls. Factors influencing displays and controls. | 09 | AUT825.6 |

**SELF-STUDY:**
> *Study on system reliability concept*

**Text Books:**

1. An Introduction to Engineering Design Method - by V. Gupta and P. Murthy, Tata McGraw Hill. 2000
2. Introduction of Engineering Design by T. Woodson, McGraw Hil1.2001

**Reference Books:**
1. Design & Planning of Engineering systems by D.D. Meredith, K.W. Wong, R.W. Wood head & K.K. Worthman. 2000
2. Introduction to Design by M.A. Asimov-Prentice Hall. 1996
3. Design Methods - Seeds of Human Futures-Wiley Inter Science.1970

  **Assessment Pattern:**

### CIE- Continuous Internal Evaluation for theory (50 Marks)

| Bloom's Category | Tests | Assignments | Quizzes | Self-Study |
|---|---|---|---|---|
| **Marks ( out of 50)** | **25** | **10** | **05** | **10** |
| Remember | 05 | | 03 | |
| Understand | 05 | | 02 | |
| Apply | 05 | 05 | | |
| Analyze | 05 | 05 | | 10 |
| Evaluate | 05 | | | |
| Create | | | | |

**SEE – Semester End Examination**

**(50 Marks – Theory)**

| Bloom's Category | SEE(Theory) |
|------------------|-------------|
| Remember | 10 |
| Understand | 10 |
| Apply | 15 |
| Analyze | 10 |
| Evaluate | 05 |
| Create | |