

**DR. A.P.J. ABDUL KALAM TECHNICAL  
UNIVERSITY UTTAR PRADESH, LUCKNOW**



## **Syllabus & Evaluation Scheme**

# **B.Voc**

**Bachelor of Vocational Studies**

**(Bachelor of Vocation)**

**3-Year Undergraduate Course**

**Based on**

**AICTE MODEL CURRICULUM**

**(EFFECTIVE FROM THE SESSION: 2021-22)**

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**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc  
Automotive Manufacturing Technology (AM)  
Branch code: 101**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

**Evaluation Scheme**  
**B. Voc Automotive Manufacturing Technology**

NSFQ Level 5 SEMESTER- I											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BAMV511	Motor Vehicle Technology –I	30	10	5	5	20	30		50	2
2	BAMV512	Automobile Electrical Equipment	30	10	5	5	20	30		50	2
3	BAMV513	Two and Three Wheeler	30	10	5	5	20	30		50	2
4	BAMV514	Modern Electric & Hybrid Vehicles	30	10	5	5	20	30		50	2
5	BAMP511	Metrology and Measuring Instruments Lab	30				20		30	50	1
6	BAMP512	Electric & Hybrid Vehicles Lab	30				20		30	50	1
7	BAMP513	Language Lab	30				20		30	50	2
8	BAMT 511	Automotive Service Technician Level 5 (ASC/Q 1403)		Any one Training 400 hrs/ 8 weeks			150			150	12
	BAMT 512	Spare Parts Operations Executive Level 5 (ASC/Q 1502)									
	BAMT 513	Industrial Engineer (Layout Design) (ASC/Q6401)									
	BAMT 514	Tool Designer (ASC/Q4001)									
	BAMT 515	Equipment Designer L5 (ASC/Q 6405)									
<b>Total</b>										<b>500</b>	<b>24</b>
NSFQ Level 5 SEMESTER- II											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BAMV521	Total Quality Management	30	10	5	5	20	30		50	2
2	BAMV522	Motor Vehicle Technology –II	30	10	5	5	20	30		50	2
3	BAMV523	Material Science and Materials	30	10	5	5	20	30		50	2
4	BAMV524	Rapid Prototyping & Reverse Engineering	30	10	5	5	20	30		50	2
5	BAMP521	Project	30				20		30	50	1
6	BAMP522	Engineering Graphics	30				20		30	50	1
7	BAMP523	Mechanical Workshop Practice Lab	30				20		30	50	2
8	BAMT521	Automotive Service Technician Level 5 (ASC/Q 1403)		Any one Training (other than 1 <sup>st</sup> sem)400 hrs/ 8 weeks			150			150	12
	BAMT522	Spare Parts Operations Executive Level 5 (ASC/Q 1502)									
	BAMT523	Industrial Engineer (Layout Design) (ASC/Q6401)									
	BAMT524	Tool Designer (ASC/Q4001)									
	BAMT525	Equipment Designer L5 (ASC/Q 6405)									
<b>Total</b>										<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

NSFQ Level 6 SEMESTER- III											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BAMV631	Automobile Electrical System	30	10	5	5	20	30		50	2
2	BAMV632	Automobile Drawing & Design	30	10	5	5	20	30		50	2
3	BAMV633	Automobile Engines	30	10	5	5	20	30		50	2
4	BAMV634	Mass Production Devices	30	10	5	5	20	30		50	2
5	BKVH631	Human Values and Professional Ethics	30	10	5	5	20	30		50	2
6	BAMP631	Automobile Workshop - I	30				20		30	50	1
7	BAMP632	Tool & Die Making Lab.	30				20		30	50	1
8	BAMT631	Automotive Service Technician Level 6 (ASC/Q1404)	Any one Training 400 hrs/8 weeks						150	150	12
	BAMT632	Automation Specialist (ASC/Q6807)									
	BAMT633	Assembly Line Machine Setter (ASC/Q3603))									
	BAMT634	Process Design Engineer (ASC/Q6404)									
	BAMT635	Quality Controller (ASC/Q1605)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>
NSFQ Level 6 SEMESTER- IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BAMV641	Automobile Engine Systems	30	10	5	5	20	30		50	2
2	BAMV642	Automotive Refrigeration and Air Conditioning	30	10	5	5	20	30		50	2
3	BAMV643	Vehicle Performance and Testing	30	10	5	5	20	30		50	2
4	BAMV644	Electrical & Hybrid Vehicles – II	30	10	5	5	20	30		50	2
5	BKVE641	Environment and Ecology	30	10	5	5	20	30		50	2
6	BAMP641	Automotive RAC Lab	30				20		30	50	1
7	BAMP642	Vehicle Performance and Testing Lab	30				20		30	50	1
8	BAMT641	Automotive Service Technician Level 6 (ASC/Q1404)	Any one Training (other than 3rd sem) 400 hrs/ 8 weeks						150	150	12
	BAMT642	Automation Specialist (ASC/Q6807)									
	BAMT643	Assembly Line Machine Setter (ASC/Q3603))									
	BAMT644	Process Design Engineer (ASC/Q6404)									
	BAMT645	Quality Controller (ASC/Q1605)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

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NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BAMV751	Automotive System Design	30	10	5	5	20	30		50	2
2	BAMV752	Plant Layout & Product Handling	30	10	5	5	20	30		50	2
3	BAMV753	Industrial Engineering& Safety Engineering	30	10	5	5	20	30		50	2
4	BAMV754	CAD & CAM	30	10	5	5	20	30		50	2
5	BKVH751	Constitution of India, Law and Engineering	30	10	5	5	20	30		50	2
6	BAMP751	CAD&CAM Lab	30				20		30	50	1
7	BAMP752	Design of Automotive Systems Lab	30				20		30	50	1
8	BAMT751	Spare Parts Operations In charge (ASC/Q1503)					Any one Training 400 hrs/ 8 weeks	150	150	12	
	BAMT752	Body Shop In-Charge (ASC/Q1413)									
	BAMT753	Service Supervisor (ASC/Q1412)									
	BAMT754	Testing Manager (ASC/Q8405)									
	BAMT755	Product Design Manager L7 (ASC/Q8103)									
<b>Total</b>										<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BAMV761	Vehicle Safety	30	10	5	5	20	30		50	2
2	BAMV762	Agile & Lean Manufacturing Systems	30	10	5	5	20	30		50	2
3	BKVH761	Indian Tradition, Culture and Society	30	10	5	5	20	30		50	2
4	BAMP761	Major Project	180						150	150	6
5	BAMT761	Spare Parts Operations In charge (ASC/Q1503)					Any one Training (other than 5 <sup>th</sup> sem)400 hrs/ 8 weeks	200	200	12	
	BAMT762	Body Shop In-Charge (ASC/Q1413)									
	BAMT763	Service Supervisor (ASC/Q1412)									
	BAMT764	Testing Manager (ASC/Q8405)									
	BAMT765	Product Design Manager L7 (ASC/Q8103)									
<b>Total</b>										<b>500</b>	<b>24</b>

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**Level 5 (Semester I)**  
**Motor Vehicle Technology – 1**

**UNIT-I :**

**Introduction & Chassis Layout**

General study of the motor vehicle with functions of its main components and assemblies (engine excluded), Development of a Tractor and its basic function and H.P. requirements, Conventional layout of chassis Front wheel drive, four wheel drive, rear engine vehicle, their advantages and disadvantages, Layout of Maruti car chassis and tractor chassis, Definitions of items-wheel track, wheel base, front and rear overhang, kerb weight, ground clearance.

**UNIT-II:**

**Clutch System**

Layout of conventional transmission system, Maruti car transmission system, Tractor transmission system, clutch - necessity, functions, requirements, types, Constructional details and working of single plate, multiple plate, diaphragm clutches, fluid coupling, Centrifugal and semi-centrifugal clutch, Tractor clutch, Clutch pedal free play. Torque transmitted by clutch, simple numerical problems. Clutch defects, probable causes, remedies.

**UNIT-III:**

**Gear Box**

Function and necessity, Construction and working details of sliding mesh, constant mesh, synchromesh gear boxes; epicyclic gear box - its applications and advantages. Over drive, Torque convertor, Maruti-800 car gear box, tractor gear box and P.T.O. shaft, 4 wheels drive auxiliary gear box. Gear ratio

**UNIT-IV:**

**Final Drive**

Torque tube drive, Hotchkiss drive, Universal joints, constant velocity joints, slip joints, Propeller shaft. Differential, slip differential, double reduction differential, final drive ratio. Tractor final drive construction and working, Rear axles-Fully floating, semi-floating, three quarter floating, Tractor axles

**UNIT-V:**

**Wheels and Tyres**

Road-wheels - Rim types and sizes, Tyres-conventional, radial, Tubeless tyre its advantages, Tyre sizes, wheels-front and rear, Tyre retreading, Tyre wear, wheel balancing, Tyre pressure, Advantages of filling nitrogen in tyres.

**Reference Books:**

1. Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House
2. Hillier's Fundamentals of Motor Vehicle Technology ,David R. Rogers, Peter Coombes, and Victor Albert Walter Hillier

## Automobile Electrical Equipment

### UNIT-I:

#### Automobile Wiring Systems & Cables

Earth-return and insulated-return systems; 6 Volt, 12 Volt and 24 Volt systems, Positive and negative earthing, Cables-starting systems cables, general purpose cables and high-tension cables; specifications and colour codes, Diagram of a typical wiring system, Wiring harness, cable connectors, circuit breakers, plastic fibre-optic wires, printed circuits, Fuses in circuits.

### UNIT-II:

#### Storage Battery

Principle of lead-acid cells; constructional details of battery plates, separator, container, terminal, vent plug, grouping compound, Electrolyte: specific gravity of electrolyte and its variation with temperature, Effect of charging and discharging of specific gravity, Capacity of battery, Efficiency of battery, Methods of charging of battery, Internal circuit of battery charger, Care and maintenance of batteries, Checking for cell voltage and specific gravity of electrolyte, Battery tests- high discharge test, cranking motor test, open-circuit voltage test, cadmium test, life test, Battery failures, Maintenance-free batteries, VRLA batteries, Traction battery, Alkaline type batteries, Fuel cell and its types, Battery Life enhancer.

### UNIT-III:

#### Dynamo

Principle of generation of D.C. Constructional details of a Dynamo, Armature reaction, Principle of commutation, Construction of commutator, Types of wound field generator series, shunt and compound wound. Other types of D.C. generators-four brush & four pole, interpole, split field and bucking field, Dyna-Starter, Generator drive.

### UNIT-IV:

#### Alternator

Principle of generation of A.C. Constructional details of an alternator, Working of alternators, Advantages over dynamo, Types of alternators, Charging of battery with an alternator, Regulator for alternators.

### UNIT V:

#### Regulators

Constant current and constant voltage systems, Double-contact and compensated voltage control regulators. Current-and-voltage regulator, Cut-out.

#### Reference Books:

1. Automotive Electricals and Electronics, A.K. Babu Khanna Publishing House
2. Automotive Electrical Equipment: PL Kohli
3. Modern Electrical Equipment: AW Judge
4. Automotive Electrical Equipment: WH Crouse



## Two and Three Wheeler

### UNIT-I: The Power Unit

Two stroke and four stroke SI & CI engine Construction and Working, merits and demerits, Symmetrical and unsymmetrical valve & port timing diagrams, scavenging process

### UNIT-II: Fuel and Ignition Systems

Fuel system – Different circuits in two wheeler fuel systems, fuel injection system. Lubrication system, Ignition systems - Magneto coil and battery coil spark ignition system, Electronic ignition System, Starting system - Kick starter system – Self-starter system, recent technologies

### UNIT-III: Chassis and Sub-Systems

Main frame for two and three wheelers, its types, Chassis and different drive systems for two wheelers, Single, multiple plates and centrifugal clutches, Gear box and its various gear control in two wheelers, Front and rear suspension systems, Shock absorbers, Panel meters and controls on handle bar, Freewheeling devices

### UNIT-IV: Brakes and Wheels

Drum brakes & Disc brakes Construction and Working and its Types, Front and Rear brake links layouts.

Brake actuation mechanism, Spoked wheel, cast wheel, Disc wheel & its merits and demerits, Tyres and tubes Construction & its Types, Steering geometry

### UNIT-V: Two & Three Wheelers – Case Study

Case study of Sports bike, Motor cycles, Scooters and Mopeds - Auto rickshaws, Pick up van, Delivery van and Trailer, Servicing and maintenance, recent developments

### Reference Books:

1 .Two and three wheeler technology, dhruv u. Panchal

## Modern Electric and Hybrid Vehicles

### **UNIT-I: Introduction**

Introduction to electric and hybrid electric vehicles, History of hybrid and electric vehicles, Social and environmental importance of electric and hybrid electric vehicles, Electrical basics, Motor and generator basics

### **UNIT-II: Electric and Hybrid Electric Drive Trains**

Basic concept of electric and hybrid traction, Introduction to various electric and hybrid electric drive train topologies, Advantages and disadvantages

### **UNIT-III: Power Flow**

Power flow control in electric and hybrid electric drive train topologies.

### **UNIT-IV: Electric Drive Components**

Introduction to electric drive components used in electric and hybrid vehicles, Electric motor requirements, Direct Current (DC) motors (Brushed and Brushless), Power converters, Drive controllers.

### **UNIT-V: Regenerative Braking System (RBS)**

Introduction and need of Regenerative Braking System, Advantages and disadvantages of RBS, Working of RBS, Concept of Regenerative Braking using Piezoelectric material, Using shock absorbers as vibration energy harvesters.

### **Reference Books:**

1. Electric & Hybrid Vehicles, A.K. Babu, Khanna Publishing House
2. Automotive Fuel Technology-Electric, Hybrid and Fuel-Cell Vehicles: Jack Erjavec& Jeff Arias
3. Electric and Hybrid Vehicles: Design Fundamentals: Iqbal Husain
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design: Mehrdadsani, Yimingao, AliEmadi.

### **Metrology and Measuring Instruments lab**

1. Measurement of angle with the help of sine bar/ Vernier Bevel protractor.
2. Study and sketch of various types of optical projectors.
3. Study and sketch of various types of comparators and use them for comparing length of given piece.
4. To measure the diameter of a hole with the help of precision balls.
5. To measure external and internal taper with the help of taper gauges, precision rollers.
6. To test the squareness of a component with auto-collimeter.
7. To measure the pitch, angle and form of thread of a screw.
8. To measure the geometry of a gear having involute profile.
9. To measure the straightness of the edge of a component with the help of autocollimeter.
10. To measure the length, breadth, thickness, depth, height with micrometer.
11. To measure the length, breadth, thickness, depth, height, with height gauge and Vernier calipers.
12. Calibration of Vernier calipers/micrometers.
13. Calibration of height gauge/depth gauge.
14. Study of a tool maker's microscope.
15. Checking of accuracy of snap gauge with slop gauge.
16. Checking of accuracy of a plug gauge with micrometer.
17. Measurement of areas by polar planimeter.
18. Use of feeler, wire, radius and fillet gauges measurement of standard parameters.

### **Electric and Hybrid Vehicles Lab**

1. Understand working of different configurations of electric vehicles
2. Understand hybrid vehicle configuration and its components, performance analysis
3. Understand the properties of batteries and its types
4. Understand of electric vehicle drive systems.
5. Understand of hybrid electric vehicles.
6. Understand Auxiliary systems including charging, starter motor, on board power supply, lighting and environmental sensing and conducting repairs. Repair & Replacement of Electric/ Hybrid Vehicle body
7. Repair & Replacement of Electric Vehicle Drive Train
8. Fault diagnosis & repair / replacement of Battery, DC & AC Electrical Machines, and Hybrid Electric Vehicles.

## Level 5 (Semester II)

### Total Quality Management

#### 1. Introduction, Basic concepts of total quality management

Introduction to Quality, Dimensions of Quality, Quality Planning, Concept and definition of quality cost, Determinants of Quality, Optimum cost of performance, Principles of TQM, Pillars of TQM, Introduction to leadership and Leadership roles, Quality council and Quality statement, Strategic Planning Process, Deming philosophy

#### 2. Continuous process improvement

Input /output process Model, Juran trilogy, PDCA Cycle, 5–‘S’ Housekeeping principle, Kaizen Seven tools of Quality (Q-7 tools), Check Sheet, Histogram, Cause and effect diagram, Pereto diagram, Stratification analysis, Scatter diagram, Control charts, Control chart for variables & process capability, Control chart for attributes

#### 3. Management planning tools & Bench marking

Affinity diagram, Relationship diagram, Tree diagram, Matrix diagram, Matrix data analysis, Arrow Diagram, Process decision programme chart (PDPC), Concept of bench marking, Reason to bench marking, Bench marking process, Types of bench marking, Benefits of bench marking

#### 4. Just in time (JIT)

JIT philosophy, Three elements of JIT, Principles of JIT Manufacturing, JIT Manufacturing building blocks, JIT benefits, Kanban & 2 Bin Systems

#### 5. Total productive maintenance (TPM)

Concept of Total Productive Maintenance, Types of maintenance, OEE (Overall Equipment Efficiency), Stages in TPM implementation, Pillars of TPM, Difficulties faced in TPM implementation.

#### Reference Books:

1. Total Quality Management, S.C. Sharma, M.P. Poonia, Khanna Publishing House

## Motor Vehicle Technology - II

### UNIT-I: Frame and Body

Function and construction of frame, Cross-section of frames, Unitized construction (monocoque) types of bodies, Terms - Turning radius, lock-to-lock angle, centre point steering, positive steering, gradeability, Idea of Safety features in a modern car.

### UNIT-II: Suspension System

Function, Types - conventional and independent, Spring types - coil, leaf - elliptical, semielliptical; helper springs, transverse springs, Spring camber; spring material, Torsion bar, stabiliser bar, Shock absorbers- telescopic and gas, Maruti suspension system and shockers, Anti-roll bars, Nitrox suspension.

### UNIT-III: Steering System and Front Axle

Principle - Ackermann and Davis, Function, requirements, Steering gear box – types, Construction and working details of worm and sector, rack and pinion, worm and wheel, worm and recalcitrating ball type, Tractor steering, Power steering, Electronic Steering, Front axle - rigid front axle, Stub axle, Elliot and reverse Elliot type, Lemoine and reverse Lemoine type, Tractor front axle, Maruti steering system, Wheel alignment - castor angle, camber angle, K.P.I., Toe-in, toe out, General values of these.

### UNIT-IV: Braking System

Braking terms - braking efficiency, stopping distance, stopping time, weight transfer during braking, leading/trailing shoe of brake, Determination of braking torque, Effect of braking on steering, Types of braking systems- constructional details and working of mechanical brakes, hydraulic brakes, parking brake, vacuum, pneumatic, air-hydraulic brakes; tractor brakes, Drum and disc brakes, Master cylinder, tandem master cylinder, wheel cylinder, Brake lining and brake fluid, Brake defects, their causes and remedies, Anti-Lock Braking System (ABS) & Electronic Brake Distribution (EBD).

### UNIT-V: Automobile Pollution and Its Control

Effects and extent of pollution caused due to stationary and automobile engines, Harmful products and their causes in petrol & diesel engines, Measures to control exhaust emissions from two-stroke engines, four-stroke engines, and diesel engines, Turbocharger, Products which cause de-activation of catalysts in catalytic converters, Unleaded petrol, Emission measuring instruments for petrol and diesel engines. Limits specified in Motor Vehicles Act. Recent trends in Automobile Pollution Control- Exhaust Gas Recirculation, Air Injection, Reactor System, Positive Crankcase Ventilation, and Evaporative Emission Control System.

### Reference Books:

1. Automobile Mechanics, A.K. Babu, S.C. Sharma, T.R. Banga, Khanna Publishing House

## Material Science & Materials

### UNIT-I:General:

Brief introduction to the subject and its scope in engineering field, classification of materials of industrial importance Their chemical thermal, electrical, magnetic, mechanical and technological properties and their selection criteria for use in industry.

### Structure of Metals and their Deformation:

Structure of metals and its relation to their physical, mechanical and technological properties, Elementary idea of arrangement of atoms in metals, molecular structures, crystal structures and crystal imperfections, Deformation of metals, effects of cold and hot working operations over them. Recovery re-crystallization and grain growth, solid solutions, alloys and inter metallic compounds, effect of grain size on properties of metals. PROPERTIES AND USAGE OF: (1) Metals: (a) Ferrous Metals (b) Non Ferrous Metals (2) Non-metallic Materials.

### UNIT-II:Metals-Ferrous Metals

1. Classification of iron and steel. (b) Cast iron types as per I.S. - White, malleable, Grey (c) Steels: Classification of steels according to carbon content and according to use as per I.S. Mechanical properties of various steels and their uses. Availability of steel in market, Its forms and specifications (d) Alloy Steel: Effect of alloying various elements, viz Cr, Ni, Co, V,W, Mo, Si, and Mn, on mechanical properties of steel, Common alloy steels, viz, Ni-steel, Ni-Cr-steel, Tungsten steel, Cobalt steel, Stainless Steel, Tool steel - High Carbon Steel, High Speed steel, Tungsten Carbide, Silicon manganese steel, Spring Steel, Heat Resisting alloy Steels etc.

### UNIT-III:NON-METALIC MATERIALS

Introduction to Plastic and Other Synthetic Materials: Plastics- Important sources-Natural and Synthetic, Classification, thermo-set and thermoplastic, Various trade names, Important Properties and engineering use of plastics. Market forms of Plastics  
Heat Insulating Materials: Classification of Heat Insulating material, properties and uses of China clay, Cork, Slag wool, Glass Wool, Thermocole, Puff, Properties and uses of asbestos as filler material.  
Hardware: General specification, uses and methods of storage of G.I. and C.I. steel, Copper, A.C. pressure conduits, R.C.C. spun, P.V.C. Pipes and their uses. General sheets specification (I.S.) and uses, Method of storage of G.I. sheets, M.S. sheets, General specification of pipe fitting

### UNIT-IV:Identification and Testing of Metal Alloys:

Selection, specification forms and availability of materials.

### Heat Treatment of Metals:

Elementary concept, purpose, Iron-carbon equilibrium diagram T.T.T. and 'S' curve in steels and its significance, Hardening, Tempering, Annealing, Normalising and case hardening

### Reference Books:

- 1 .MATERIAL SCIENCE: RS Khurmi& RS Shedha
- 2.Materials Science and Engineering,WilliamCallister

## Rapid Prototyping & Reverse Engineering

### UNIT-I:Introduction:

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

### UNIT-II:CAD Modelling and Data Processing for RP:

CAD model preparation, Data Requirements, different types of Data formats, Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

### UNIT-III:RP Systems:

Photo-polymerization process, Powder Bed Fusion process, Applications of Powder Bed Fusion Processes, Extrusion - Based RP Systems, 3D Printing process modeling, Applications of Printing Processes. Sheet Lamination process /Laminated Object Manufacturing (LOM), Beam Deposition: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing - structure-properties, relationships, Benefits and drawbacks.

### UNIT-IV:Rapid Tooling:

Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

### UNIT-V:RP Applications:

Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

### Reference Books:

- 1.Reverse Engineeringby Kiran J. Fernandes (Editor), Vinesh Raja (Editor)
- 2.Rapid Prototyping - Theory and Practice | Ali K. Kamrani | Springer

### Project

On the basis of learning in the vocational diploma, a project to be taken up by the student strengthening his/ her vocational skills

## Engineering Graphics

### 1. Introduction

Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used toolbars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.

### 2. Orthographic Projections

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes

### 3. Orthographic Projections of Plane Surfaces (First Angle Projection Only)

Introduction, Definitions—projections of plane surfaces—triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only.

### 4. Projections of Solids (First Angle Projection Only)

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.

### 5. Sections and Development of Lateral Surfaces of Solids

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.

### 6. Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of Tetrahedron, hexahedron (cube), right regular prisms, pyramids, cylinders, cones, spheres, cut Spheres.

#### Reference Books:

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, 48th edition, 2005-Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition- 2006.
3. Engineering Graphics - K.R. Gopalakrishna, 32nd edition, 2005- Subash Publishers Bangalore.
4. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, 2005-Prentice-Hall of India Pvt. Ltd., New Delhi.



## Mechanical Workshop Practice

1. SHEET METAL WORKING AND SOLDERING:
  - a. (EX-1) Cutting, shearing and bending of sheet.
  - b. (EX-2) To prepare a soap case by the metal sheet
  - c. (EX-3) To make a funnel with thin sheet and to solder the seam of the same
  - d. (EX-4) To make a cylinder and to solder the same
2. FITTING SHOP WORK:
  - a. (EX-1) Hack sawing and chipping of M.S. flat
  - b. (EX-2) Filing and squaring of chipped M.S. job
  - c. (EX-3) Filing on square of rectangular M.S. Plate
  - d. (EX-4) Drill a hole in MS Block & tapping the same
  - e. (EX-5) Making a Bolt & Nut by Tap & Die set.
3. SMITHY SHOP WORK:
  - a. (EX-1) To prepare square angular piece by M.S. rod
  - b. (EX-2) To make square or hexagonal head bolt
  - c. (EX-3) To make a screw driver with metallic handle
  - d. (EX-4) To make ring with hook
4. Tin Smithy, Soldering, Brazing
  - a. (EX-1) To prepare different types of joint such as lap joint single seam, double seam & cap joint-hem & wired edge.
  - b. (EX-2) Utility article-waste paper basket or paper tray
  - c. (EX-3) Study & sketch stakes / anvils.
5. WELDING SHOP WORK:
  - a. (EX-1) Welding practice gas & electric arc welding
  - b. (EX-2) Welding for lap joint after preparing the edge
  - c. (EX-3) Welding Butt joint after preparing the edge
  - d. (EX-4) Gas Cutting
  - e. (EX-5) `T' joint welding after preparation of edge.

### Reference Books:

1. Workshop Technology, Vol. I: Hazra&Chaudhry
2. Elements of Workshop Technology Vol. I: BS Raghuwanshi

## Level 6 (Semester I)

## Automobile Electrical System

### UNIT-I:STARTING SYSTEM

Principle, construction and working of starter motor. Series motor and its characteristics, Compound wound motor, Engine starting circuit, Starter drives-Bendix (torsion, compression), over-running clutch and sliding armature types. Starter switch - manual, solenoid, Factors affecting the starting of engines, Torque terms. Starting torque and power required, Motor efficiency, Armature reaction, typical motor specifications

### UNIT-II:IGNITION SYSTEM OF SPARK-IGNITED ENGINES

Types of ignition systems- battery and coil, magneto ignition systems, Ignition circuit, Details of the ignition system-ignition coil, distributor, condenser, contact breaker points, rotor, distributor cap, distributor drive, Firing order, Ignition timing, Ignition advance and retard, need, and factors it depends upon, Methods for obtaining advance and retard vacuum and mechanical, Optical sensor for spark timing.

**UNIT-III:**Spark plugs-constructional details; types used in automobiles, conditions of working of spark plugs, Glow plugs of diesel engines, Magneto-rotating armature and rotating magnet types, Electronic ignition of cars & motor-cycles (CDI), Idea of Distributor-less Direct ignition system.

### UNIT-IV: LIGHTING SYSTEM

Requirements of automobile lighting, Head lamp - mounting and construction; Plastic headlamp Lens, sealed beam assembly, Asymmetrical head light, dipper and full beam, care of headlamp, Lens cleaners, Dynamic headlight beam control, Advanced Front lighting system (AFS) Types of bulbs, Reflector optics. Light sources – tungsten light Sources, tungsten halogen light sources, halogen infrared reflective light sources, HID light sources (Xenon and bi-xenon), LED light sources, Blue vision head lamp, Auxiliary lights, Brake light, Fog light, Flasher unit, warning lights and panel lights.

### UNIT-V:ACCESSORIES

Fuel and oil pressure gauge, cooling water temperature gauge, electrical speedometer, ampere meter, wind-screen wiper, electrical horn and relay, cigarette lighter, Odometer, wind-shield washing equipment, engine rpm meter, glow plug indicator, cluster assembly, Radio and television Interference suppressors, electrical switches. Central locking of doors, power winding of window panes, car heaters AC, blower and air flow controls, Rear defogger.

### Reference Books:

1. Automotive Engines, A.K. Babu, Khanna Publishing House
2. Automotive Electrical Equipment, Kohli

## Automobile Drawing & Design

**UNIT-I:**Drafting of sectional views of the following assemblies: (a) Cylinder block and crankcase of 2-wheeler, (b) Poppet valve assembly of a 4-stroke engine, (c) Piston assembly, (d) Connecting rod assembly, (e) Spark plug, (f) Injector.

**UNIT-II:**Free hand line diagram of the following systems: (a) Fuel system of petrol engine (b) Fuel system of diesel engine (c) Cooling system of a multi-cylinder engine (d) Lubricating system of a multi-cylinder engine (e) Steering system of Maruti (f) Suspension systems of Maruti (g) Hydraulic Braking System of Maruti Zen (h) Air Hydraulic Braking System of TATA (i) Block diagram of Electronic Fuel Injection (EFI) system (j) Block diagram of Common Rail Direct Injection (CRDI) system (k) Oxygen sensor (l) Fuel injector of EFI.

**UNIT-III:**Drafting of sectional views of the following assemblies (1) Master cylinder (2) Wheel cylinder (3) Universal joint

**UNIT-IV:**Sketch layouts of (a) Depot (b) F.I. pump reconditioning shop (c) Electrical Workshop.

**UNIT-V:**Design of the following components of an automobile engine (1) Piston assembly (2) Connecting rod assembly (3) Crank shaft (4) Flywheel

**Reference Books:**

1. Automobile Drawing: RB Gupta

## Automobile Engines

**UNIT-I:**(A) Fundamentals of Thermodynamics: Internal energy, Enthalpy, Mechanical Equivalent of Heat, Conservation of energy, First and Second Law of thermodynamics, P-V diagram, Reversible process, Various thermodynamic processes, Entropy, General case for change of entropy of a gas, Change of entropy during various processes, Temperature-entropy diagram, Simple numerical problem.

(B) Air standard cycles: Otto cycle, Diesel cycle, Air standard efficiency of Otto and Diesel cycle, Effect of compression ratio on efficiency, Simple numerical problem, Graphical representation of ideal and actual cycle, Comparison between actual and ideal cycles, Reasons for variation, Mean effective pressure, Work done during the cycle.

**UNIT-II:** (A) I.C. Engines' operation: Working of two stroke cycle and four stroke cycle petrol and diesel engines. Valve timing diagrams. Port timing diagrams, Classification of I.C. Engines. (B) Reciprocating Engine Details: Construction, function, material and manufacturing process of: (a) Cylinder Block- 2-stroke air cooled and 4-stroke water cooled cylinder liner (wet and dry), cylinder head, gaskets, Different cylinder arrangements. Cylinder wear, Forms of combustion chamber in petrol engine, Location of spark plug, Combustion chamber in Diesel engines, Turbulence in Combustion chambers.

**UNIT-III: Engines Details (continued)(b) Piston**-plain, split skirt, auto-thermic, cam-ground, Anodising and Tinning of piston, Piston clearance (c) Piston rings-different types (d) Piston pin; different methods of fitting piston pin (e) Valves: Poppet, Rotary, reed, Poppet Valve arrangement, Overhead and side valve operating mechanism, Valve clearance, Hydraulic tappet. Sodium cooled valves. Valve seat inserts (f) Connecting rod, Section of connecting rod, Bearing metal for big and small end of connecting rod (g) Crank shaft, Left hand, right hand crankshaft, Balancing of crank shaft (General idea about static and dynamic balancing, problems excluding,. Main bearings Crankshaft end play. Vibration damper. Flywheel (h) Camshaft, Camshaft drive timing gears (i) Inlet and exhaust manifold, Mufflers, Exhaust pipe (j) Variable Valve Timing (VVT).

**UNIT-IV:** Rotary Engine, Principle and operation, Engine cooling, Advantages and limitations. (B) Internal combustion Turbine, Principle of working, Classification, Brayton cycle, Cycle efficiency, Friction effect, Optimum compression ratio, Simple numerical problems, Deviation of practical cycles, Methods to improve efficiency, Turbine characteristics, combustion chamber, Fuel injection, Ignition Gas turbine Fuels, Materials, Turbine blades.

**UNIT-V:** Supercharging and scavenging. Necessity of supercharging, Rotary compressors, Turbocharger requirement, Effect of supercharging on power output, mechanical losses, fuel consumption, detonation, Limitations of supercharging, Methods and classification of scavenging process, Performance of different scavenging systems. (B) Engine specifications, specifications of engines of Indian vehicles - four wheelers, three wheelers and two wheelers.

### Reference Books:

1. Automotive Engines, A.K. Babu, Khanna Publishing House
2. Thermal Engineering I & II: Sarao, Gambhir & Aggarwal
3. Automobile Engineering II: Kirpal Singh
4. Basic Automobile Engineering: CP Nakra
5. Automobile Engineering: RB Gupta

## Mass Production Devices

### UNIT-I: Tool holders:

Tool holders for turning and milling carbide inserts-types, ISO-designation and applications, Tool holding and tool mounting systems for conventional milling and drilling machine tools.

### UNIT-II: Locating and clamping devices:

Concept, meaning and definitions of location and clamping, Use of locating and clamping principles in day-to-day supervision on shop floor, Degree of freedom-concept and importance, 3-2-1 principle of location, Locators-Types, Sketches with nomenclature, Working, Applications, Fool proofing and ejecting

### UNIT-III: Clamping devices:

Types, Sketches with nomenclature, Working, Applications

### UNIT-IV: Jigs and fixtures:

Concept, meaning, differences and benefits of jigs and fixtures, Types, sketches with nomenclature, working and applications of jigs, Types, sketches with nomenclature, working and applications of fixtures,

### UNIT-V: Design of Jigs and Fixtures:

Steps in designing jigs and fixture for given simple component

### Reference Books:

1. Mass Production, Products from Phaidon Design Classics
2. Mass-production management, design and operation of production flow-line systems Hardcover – 1972 by Ray Wild (Author)

## Automobile Workshop -I

**UNIT-I:** Engine tuning: Meaning and scope of engine tuning. Necessity of engine tuning, Service data of Maruti: Alto, WagonR, Swift (Petrol & Diesel); Hyundai: Santro, Ford: Figo; Volkswagen: Polo; Chevrolet: Spark. Engine analysis and tuning with the help of diagnostic computer, Diesel engine injection timing checking

**UNIT-II:** Wheel Balance: Reasons of wheel imbalance, Effect of wheel imbalance on stability of vehicle. Static and dynamic balancing, Wheel balancing by the application of weights, Wheel Alignment: Meaning of wheel alignment, Various angles-camber, caster, KPI & toe - and their effect on steering stability, General values of popular Indian vehicles, Wheel alignment on computerized wheel aligner

**UNIT-III:** Measurement of Exhaust Pollution by various analyzers such as Four Gas Analyser, Smoke meter, Noxanalyser

**UNIT-IV:** Use of Headlight aligner, Wheel aligner, automotive oscilloscope

**UNIT-V:** Servicing: Meaning and scope of servicing, Items attended to in servicing of a vehicle. Servicing a vehicle, Focusing and alignment of head lights

**Reference Books:**

1. Engine Service: Gary Lewis
2. Various Car's Manuals

**Tool & Die Making Lab**

1. Manufacture of Box Jig and Angle plate jig
2. Manufacture of "V" Block angle grinding Fixtures and profile milling fixture
3. Manufacture of simple Blanking & piercing Tool
4. Manufacture of Progressive tool for producing a Cycle chain link
5. Manufacture of Press tools like Combination tool & Compound tool
6. Manufacture of Draw tool
7. Trial out On Fly press and power press the Produced components such as V, U, Cycle link, Cup, Washer and Cycle bell cup
8. Manufacture of simple V and U bending tool
9. Maintenance of Jig & fixture and press tool

## Level 6 (Semester II)

### Automobile Engine Systems

**UNIT-I:STARTING SYSTEM:** Idea of engine starting-system circuit, Kick-starting system of 2 wheelers,Starting of mopeds. **IGNITION SYSTEM:** Idea of Battery-and-coil ignition circuit and its working Compression ignition of diesel engines, **LUBRICATION SYSTEM:** Lubrication in 2 stroke engines - petrol and oil-injection. Lubrication in 4 stroke multi-cylinder petrol/diesel engines, Dry and wet sump lubrication, Full pressure and semi-pressure lubrication, Oil pump types, Oil pump drive, relief valve; pressure gauge. Oil filters, Full-flow and by-pass type filtering system, Crankcase dilution, crankcase ventilation,Positive Crankcase Ventilation, Properties and functions of a good lubricating oil, Additives, Gradation of lubricating oil due to viscosity, SAE numbers, Service rating, 2T and Super 2T oils for use in 2-s engines.

**UNIT-II:COOLING SYSTEM:** Necessity of cooling of I.C. engines, Methods of cooling-air cooling, water cooling, liquid cooling, Shape of cooling fins, Field of application of air cooling, Water cooling system - Thermo siphon system, pump system, thermostat system of cooling, Thermostat – types, Radiators-different types, their construction and function, Pressurized cooling system; radiator pressure-cap, surge tank, Cooling water temperature gauge, Antifreeze and anti-corrosive additive, Coolants, Flushing of cooling system.

**AUTOMOBILE ENGINE FUELS:** Types of fuels, Influence of structure, Calorific value, Requirements in fuels for I.C. engines, Properties, Fuel rating, Additives for S.I. and C.I. engine fuels, Specifications of petrol and diesel, Leaded and un-leaded petrol, Low Sulphur diesel, Enhancing Power output- Nitrox injection, Non-conventional fuels - LPG, CNG ethanol-mixed petrol, Properties, method of manufacture and their performance as I.C. engine fuels. Engine modifications required, Dual mode engine, Idea of Electric Vehicles and Hybrid Vehicles.

**UNIT-III:FUEL SYSTEM OF DIESEL ENGINES:** Fuel supply system,Filters (primary and secondary) positioning of filters, Feed pump, Solid and air injection system, Fuel injection pump, different types-plunger, distributor pump, their construction and working, Injectors, Governors, Types of governing, Combustion process in diesel engine, Diesel knock, Electronically Controlled Diesel Injection Pump, Common Rail Direct Injection, Piezoelectric effect and its use in CRDI.

**UNIT-IV:FUEL SYSTEM OF PETROL ENGINES:** Gravity feed system used in 2-wheelers, Fuel supply circuit of 4-wheelers, Mechanical and electrical fuel pump, Electric fuel gauge, Petrol fuel filter, Air/fuel ratio, Variation of air/fuel ratio with speed, Air cleaners (wet & dry), Cyclone filter, CARBURETOR - Function and principle of working of simple carburetor, Carburetor controls- throttle, choke, Types of Carburetors- fixed jet carburetor (Solex type) and constant vacuum carburetors used in YAMAHA motorcycle, Twin-barrel carburetors, Classification of carburetors, Disadvantages of carburetors, Phenomenon of combustion and detonation, Pre-ignition.

**UNIT-V:FUEL INJECTION SYSTEMS (PETROL ENGINE):** TBI, MPI, the Electronic Module,and Advantages of Electronic Fuel Injection (EFI), Block diagram of the EFI, The Air Intake System and the Idle Air Control System. Fuel Delivery System, Various sensors used with the ECM, their location and purpose, Fuel Injector, Idea of Gasoline Direct Injection **ENGINE PERFORMANCE AND TESTING:** Various losses in an engine, Heat balance, Morse method of finding IHP, Calculation of various quantities like IHP, BHP, mechanical efficiency, thermal efficiency, relative efficiency, overall efficiency, specific fuel consumption. Performance curves.

#### Reference Books:

1. Automotive Engines, A.K. Babu, Khanna Publishing House

## **Automotive Refrigeration & Air-conditioning**

### **UNIT-I:Refrigeration Fundamentals:**

Introduction to refrigeration and vapour compression system, cycle diagram (Carnot cycle, Reverse Carnot cycle, Simple vapour compression cycle, bell Coleman cycle), effects of various operating parameters on performance of A/C System, Vapour absorption refrigeration system (No numerical), Applications of refrigeration and air conditioning.

### **UNIT-II:Refrigerants and Air conditioning Components:**

Environmental concerns/Legislation for automotive A/C systems, types and properties of refrigerants, refrigerant oils, refrigerant piping. Future refrigerants, Air conditioning components: Compressors, Condensers, flow control devices, evaporators – Design guidelines, types, sizing and their installation. Accumulators, receiver driers and desiccants, Refrigerant charge capacity determination

### **UNIT-III:Air distribution system:**

Comfort conditions, Air management and heater systems, air distribution modes (Fresh/Recirculation, Face, Foot, Defrost, and Demist), A/C ducts and air filters. Blower fans, Temperature control systems (manual/semiautomatic, automatic). Vehicle operation modes and Cool-down performance

Psychrometry: Psychrometric properties, tables, charts, Psychrometric processes, Processes, Combinations and Calculations, ADP, Coil Condition line, Sensible heat factor, Bypass factor.

### **UNIT-IV: Load analysis and control devices:**

Load Analysis, Outside and inside design consideration, Factors forming the load on refrigeration and air conditioning systems, Cooling and heating load calculations, Load calculations for automobiles, Effect of air conditioning load on engine performance, Air conditioning electrical and electronic control, pressure switching devices, sensors and actuators.

### **UNIT-V: Diagnostics, Trouble Shooting, Service and Repair:**

Initial vehicle inspection, temperature measurements, pressure gauge reading and cycle testing, leak detection and detectors, Sight glass, Refrigerant safety/handling, refrigerant recovery; recycle and charging, system oil, system flushing, odour removal, retrofitting, Removing and replacing components, Compressor service.

### **Reference Books:**

1. Refrigeration & Air Conditioning, Sadhu Singh, Khanna Publishing House



## Vehicle Performance & Testing UNIT-I:

### Vehicle Performance Parameters:

Vehicle Performance parameters: Fuel economy, acceleration, deceleration, grad ability, top speed, handling, comfort, life durability, EGR systems, Impact of vehicular systems on performance: Suspension system, Steering system, Brakes, Tyres, carriage unit. Catalytic converters function and construction, Lambda close loop control system for gasoline vehicles.

### UNIT-II: Drive train and Component testing:

Vehicular transmission performance: comparison of automotive clutches, Epicyclic transmission, torque converter, final drive and differential, testing of vehicle components: clutch, gear box (for noise and shifting force), brake testing, wheels and tyre testing – tyre wear pattern identification and causes.

### UNIT-III: Vehicle testing:

Vehicle Testing - Road test, free acceleration test, coast down test, passer by noise test, road load data acquisition for vehicle. Test tracks: Proving ground testing, high speed track, pavement track, corrugated track, mud track, steering pad, gradient track, deep wading through shallow water Laboratory testing: Testing on chassis dynamometer, transition testing (Euro III onwards), accelerated testing, virtual testing, evaporative emission testing, oil consumption testing, endurance test, high speed performance test. Collisions and Crash Testing: Crash testing: Human testing, dummies, crashworthiness, pole crash testing, rear crash testing, vehicle to vehicle impact, side impact testing, crash test sensors, sensor mounting, crash test data acquisition, braking distance test.

### UNIT-IV: Comfort, Convenience and Safety:

Seats: types of seats, driving controls accessibility, and driver seat anthropometry. Steering: steering column angle, collapsible steering, and power steering. Adaptive cruise control, navigation system, adaptive noise control, driver information system, Safety: Motor vehicle safety standards, active safety, passive safety, bio-mechanics Structural safety, energy absorption, ergonomic consideration in safety.

### UNIT-V: Noise Vibration and EMI:

Noise and vibration: Mechanism of noise generation, engine noise and vibration, causes and remedies on road shocks, wind noise and measurement. Automobile testing instrumentation: Sensors types and selection, instrumentation for functional tests, model test and full scale testing.

### Reference Books:

1. Road Vehicle Performance: Methods of Measurement and Calculation, George Gordon Lucas
2. The Engineering Principles of Vehicle Performance Testing, FrontCover, Fredrick James Furrer

## Electrical & Hybrid Vehicles – II

### UNIT-I:Hybrid Architecture and Power

#### Plant Specifications:

Series configuration locomotive drives- series parallel switching- load tracking architecture, Pre transmission parallel and combined configurations Mild hybrid- power assist- dual mode- power split- power split with shift- Continuously Variable transmission (CVT) wheel motors, Grade and cruise targets- launching and boosting- braking and energy recuperation- drive cycle implications.

#### UNIT-II:Sizing the Drive System and Energy Storage Technology:

Matching electric drive and ICE; sizing the propulsion motor; sizing power electronics. Battery basics; lead acid battery; different types of batteries; battery parameters

#### UNIT-III:Fuel Cells:

Fuel cell characteristics- fuel cell types – alkaline fuel cell- proton exchange Membrane; direct methanol fuel cell- phosphoric acid fuel cell- molten carbonate fuel cell- solid oxide fuel cell- hydrogen storage systems- reformers- fuel cell EV- super and ultra-capacitors- PEM fuel cell vehicles.

#### UNIT-IV:Energy Storage:

Battery based energy storage: Battery basics, Lead acid (Pb-Acid) battery, Nickel-Cadmium (NiCd) battery, Nickel-Metal-Hydride (NiMH) battery, Lithium-ion (Li-ion) battery, Lithium-polymer (Li-poly) battery, Ultra capacitors.

#### UNIT-V:Nonelectric Hybrid Systems:

Short term storage systems flywheel accumulators, continuously variable transmissions hydraulic accumulator's hydraulic pumps/motors- pneumatic hybrid engine systems operation modes.

#### Reference Books:

1. Electric & Hybrid Vehicles, A.K. Babu, Khanna Publishing House
2. Electric and Hybrid Vehicles, Tom Denton

### **Automotive RAC Lab**

1. Test on vapor compression test rig.
2. Test on air conditioning test rig.
3. Study of various methods of transport refrigeration systems.
4. Study and demonstration on car and bus air conditioning system.
5. Study of latest trends in automotive refrigeration systems.
6. Study and demonstration of controls in refrigeration.
7. Study of different components with the help of cut sections/models/charts- Compressor, Condenser, Evaporators, Expansion device, Blower fans, Hating systems etc.
8. Study of installation/operations/maintenance practices for refrigeration systems.
9. Study of leak testing and leak detection methods.
10. Visit to maintenance shop of automotive air conditioning and writing report on it.

### **Vehicle Performance & Testing Lab**

1. Estimation of power requirement for vehicle propulsion by taking actual vehicle example.
2. Perform coast down test to find vehicle inertia.
3. On road fuel consumption test at different speeds.
4. Brake efficiency measurement
5. Pass- by noise test.
6. Free acceleration test.
7. Vibration measurement in passenger compartment
8. Laboratory testing of vehicle on chassis dynamometer for performance
9. Laboratory testing of vehicle on chassis dynamometer for emission.
10. Report based on visit to vehicle testing and research organization.
11. On road emission testing of petrol and diesel vehicles for PUC/RTO

## Level 7 (Semester I)

### Automotive System Design

#### **UNIT-I: Design of Clutches & Gearbox:**

Design requirements of friction clutches, selection criterion, torque transmission capacity, lining materials, Design of single plate clutch, mutilate clutch and centrifugal clutch. Selection of gear ratios and final drive ratio, numerical on 3- speed and 4- speed gearbox.

#### **UNIT-II: Design of Propeller Shafts and Axles:**

Design of propeller shafts for bending, torsion and rigidity, Design of universal joints and slip joints, final drive, Design of live and dead axles.

#### **UNIT-III: Brake Systems:**

Design of hydraulic braking system, internal expanding shoe brake and disc brake, design of master and wheel cylinder and piping design.

#### **UNIT-IV: Design of Suspension and Steering System:**

General design considerations of suspension system, design of helical and leaf springs for automobile suspension system, design considerations of Belleville springs, elastomeric springs, design considerations of steering system and vehicle frame design.

#### **UNIT-V: Statistical Consideration in Design and Optimization:**

Ergonomics and aesthetic design, statistics in design, design for natural tolerances, statistical analysis, and mechanical reliability, introduction to design optimization of mechanical elements, adequate and optimum design, methods of optimization, Johnson's method of optimum design-simple problems in optimum design like axially loaded members.

#### **Reference Books:**

1. Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House

## Plant Layout & Product Handling

**UNIT-I Objective of Facility Design:** Types of layout problems, the layout function, organization of layout. Analysis and Design of Material Flow: Systems approach to flow cycle, process charts, flow process charts, Quantitative analysis of material flow; optimal material flow configuration. Space and Area Allocation for Production and Physical Plant Services;

**UNIT-II Computerized handling of layout algorithms;** Algorithms for computerized Layout Planning, Construction and Development type of computerized Layout Planning Techniques i.e. CRAFT, ALDEP, CORELAP etc.;

**UNIT-III Product handling;** Design of system configurations conforming to various kinds of product features and layout characteristics; Design concepts of common handling and transfer equipment; Different types of conveyors, elevators, fork lifters;

**UNIT-IV** Design concept of warehouse facilities commensurate with adopted kind of handling and transfer devices; Automated Handling of materials, Automated Transfer lines, AGVS, Use of Robots in Product handling, automated packaging devices.

### UNIT-V

Application of pneumatic and hydraulic system in transportation and handling of products, Design of integrated plant layout for product handling systems

#### Reference Books:

1. Plant Layout and Materials Handling, R. B. Choudhary, G. R. N. Tagore
2. Plant Layout And Material Handling (Paperback, G.K. Agarwal)

## Industrial Engineering & Safety Engineering

**UNIT-I:INSPECTION:** Inspection and its objective, Types of inspection, Inspection standards, Duties of inspection foreman, QUALITY CONTROL: Concept of quality control, elements of quality control, quality control groups, objectives of quality control, Statistical quality control, objectives of S.Q.C. Inspection by variables & attributes, Frequency distribution, mean, median & mode, standard deviation, X-R charts, P-Charts, C-Charts and acceptance sampling. (i) I.S.O. 9000 (ii) KAIZEN (iii) Six Sigma (iv) 5S (v) TQM system, concept & brief idea only

**UNIT-II:WORK STUDY:** Method study-Process chart, Flow process chart, Flow diagram, Man and Machine chart, gang process chart, Work Measurement-Time study, Tools used in time study, Performance rating, Allowance and use of time standard, Time and Motion Study. Principles of human motion economy, Micro-motion study, Memo motion study, Therbligs, left hand and right hand chart.

**UNIT-III:CPM & PERT:** Introduction to CPM, language of CPM net work. Diagram map for CPM chart, arrow diagram method of CPM, Programme Evaluation & Review Technique (PERT) Activity event net work (simple manual cases only), Project scheduling with CPM & PERT.

**UNIT-IV:PLANT LAYOUT:** General plant location factors, Influence of location on plant layout, selection of plant site, Product layout, Process layout, Advantages and disadvantages of process layout and product layout. GENERAL: Standardization, sources of standard, value of standardization, Production Planning & Control-Introduction, concept of planning, scheduling routing & dispatching and follow up functions. Need for Production, Planning and Control.

**UNIT-V:MATERIAL HANDLING:** Material Handling & material handling equipment, factors in material handling problems, cost reduction through improved material handling, Reduction in time of material handling, Material handling equipment-Idea about lifting lowering devices, Transportation devices, combination devices, Maintenance of material handling equipment.

**INDUSTRIAL SAFETY:** Need for safety-Legal, humanitarian, economic and social considerations. Safe working conditions and productivity, Unsafe conditions and hazards, Safety Engineering-General safety devices used on machines, Manual handling and storage of material, Mechanical handling of materials. Value Engineering, Meaning of Value, Value Analysis, reasons for unnecessary costs, selection of a product for value engineering, Data collection and analysis, TEN Commandments of Value Engineering, Brief idea of J.I.T. manufacturing and Kanban System.

### Reference Books:

1. Industrial Safety, S.C. Sharma, Khanna Publishing House
2. Industrial Engineering Safety and Pollution ,Sanjai Kumar Gupta

## CAD & CAM

### **UNIT-I: Introduction CIM and CAD & Analysis:**

CIM: Introduction of CIM– concept of CIM - evolution of CIM – CIM wheel –Benefits – integrated CAD/CAM. CAD: Introduction– CAD definition – Shigley’s design process – CAD activities – benefits of CAD. Types of CAD systems, CAD software packages, 2D & 3D transformations, Geometric modeling: Techniques: Wire frame modeling – surface modeling – solid modeling

### **UNIT-II: Computer aided Manufacturing CAM:**

Definition, functions, benefits. Group technology – Part families - Parts classification and coding - coding structure – Optiz system, MICLASS system and CODE System - process planning – CAPP – Types of CAPP : Variant type, Generative type – advantages of CAPP – production planning and control – computer integrated production management system – Master Production Schedule (MPS) – Capacity planning – Materials Requirement Planning (MRP) –Manufacturing Resources Planning (MRP-II)

### **UNIT-III: CNC Machine and Components:**

CNC Machines: Numerical control – definition – components of NC systems – development of NC – DNC – Adaptive control systems – working principle of a CNC system – Features of CNC machines - advantage of CNC machines – difference between NC and CNC – Construction and working principle of turning centre – Construction and working principle of machining centers – machine axes conventions turning centre and machining centre – design considerations of NC machine tools.

### **UNIT-IV: Part Programming:**

NC part programming – methods – manual programming – conversational programming – APT programming - Format: sequential and word address formats - sequence number – coordinate system – types of motion control: point-to-point, paraxial and contouring – Datum points: machine zero, work zero, tool zero NC dimensioning – reference points – tool material – tool inserts - tool offsets and compensation - NC dimensioning – preparatory functions and G codes, miscellaneous functions and M codes – interpolation: linear interpolation and circular interpolation.

### **UNIT-V: FMS, Integrated Material Handling and Robot:**

Types of manufacturing - introduction to FMS – FMS components – FMS layouts – Types of FMS: flexible manufacturing cell – flexible turning cell – flexible transfer line – flexible machining systems – benefits of FMS - introduction to intelligent manufacturing system – virtual machining. Computer Integrated material handling – AGV: working principle – types, benefits – Automatic Storage and Retrieval Systems (ASRS).ROBOT – definition – robot configurations – basic robot motion – robot programming method – robotic sensors - industrial applications: characteristics, material transfer, machine loading, welding, spray coating, assembly and inspection.

### **Reference Books:**

1. Engineering AutoCAD, Pradeep Jain & A.P. Gautam, Khanna Publishing House
2. Engineering Graphics and Design, Pradeep Jain & A.P. Gautam, Khanna Publishing House

### **CAD Lab & CAM Lab**

1. Introduction and different features of the CAD Software.
2. 2-D Drafting.
3. 3-D Modeling.
4. 3-D Advanced Modeling.
5. Assembly modeling.
6. Feature Modification and Manipulation
7. Detailing.
8. Sheet Metal Operations.
9. Surface Modeling.
10. To prepare part programming for plain turning operation.
11. To prepare part programming for turning operation in absolute mode.
12. To prepare part program in inch mode for plain turning operation.
13. To prepare part program for taper turning operation.
14. To prepare part program for turning operations using turning cycle.
15. To prepare part program for threading operation.
16. To prepare part program for slot milling operation.
17. To prepare part program for gear cutting operation.
18. To prepare part program for gear cutting using mill cycle.
19. To prepare part program for drilling operation

### **Design of Automotive Systems Lab**

1. Design of automotive clutch assembly and component drawing using any drafting software (Two full imperial sheets along with design calculations report) consists of:
  - Functional design of clutch
  - Design of clutch shaft, hub and flange
  - Design of damper springs
  - Design of sectors, rivets etc.
  - Design of pressure plate assembly
  - Design for linkage mechanism
  - Details and assembly drawing
  - Details and assembly drawing
2. Design of automotive gear box along with reverse gear (Two full imperial sheets along with design calculations report) consists of:
  - Calculation of gear ratios
  - Determination of number of teeth on gear pair
  - Determination of gear reductions
  - Design of gear pairs
  - Design of shafts
  - Selection of bearings
  - Details and assembly drawing
3. Design of suspension spring and its analysis using any analysis software.



## Level 7 (Semester II)

### Vehicle Safety

**UNIT-I:** Introduction to vehicle safety, Basic concepts of vehicle safety, Risk evaluation and communication Human error control, Universal design, The distracted driver, Crash Testing

**UNIT-II:** Accident Data, Biomechanics and Occupant Simulation, Vehicle Body Testing, Dynamic Vehicle Simulation Tests, Occupant Protection, Pedestrian Protection, Compatibility, Interrelationship Among Occupants, Restraint Systems and Vehicle in Accidents, Significance of Rear Crash Safety, Role of seat in Rear crash safety, Performance criteria for different seats, Ultra high Retention seats

**UNIT-III:** Introduction to Accident Analysis Reconstruction methods, Uncertainty in Measurement and cautions Tire forces, Straight-line Motion, Critical speed from Tire Yaw marks, Reconstruction of Vehicular Rollover Accidents, Analysis of Collisions, Reconstruction Applications, Impulse Momentum Theory Crush Energy, Frontal Vehicle –Pedestrian Collision, Photogrammetry for accident constructions

**UNIT-IV:** Antilock braking system, Traction control system, Electronic Stability Program, Low tire pressure warning system, Collision avoidance systems

**UNIT-V:** Automotive Industry Standards, Transport Engineering Standards, Indian road congress Standards

#### Reference Books:

1. Automotive Vehicle Safety, Book by Barbara J. Peters and George A. Peters
2. Vehicle Safety Communications Book by Luca Delgrossi and Tao Zhang

## **Agile and Lean Manufacturing**

### **UNIT-I:Introduction**

Introduction to Just in time production, Toyota production system, Introduction to lean manufacturing (LM), history of LM, advantages of LM over mass production

### **UNIT-II: Waste Identification**

Types of wastes, lean manufacturing principles; Value, value stream, flow, pull and perfection

### **UNIT-III:Value stream mapping**

Introduction to value stream mapping, types of value stream mapping, value added activities, necessary non value added activities, non-value added activities

### **UNIT-IV:Lean manufacturing tools**

Introduction to 5S, Kanban, kaizen, work standardization, Statistical process control, automation and other lean tools

### **UNIT-V:Agile manufacturing**

Introduction to agile manufacturing, advantages of agile manufacturing, differences with lean manufacturing.

### **Reference Books:**

1. Lean and Agile Manufacturing, Devadasan S.R
2. Agile and Lean Program Management, Johanna Rothman

## Process Planning and Control

**UNIT-I:** Introduction, components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Selection of forecasting technique.

**UNIT-II:Capacity Planning-**

Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost-Volume analysis.

**UNIT-III:Facility Location-**

Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, Fixed position, combination and cellular layouts; Designing product and process layout, line balancing.

**UNIT-IV:Production Control-**

Capacity control and priority control, production control functions; Routing, scheduling, dispatching, expediting and follow up, Techniques of production control in job shop production, batch production and mass production systems

**UNIT-V:Sequencing-**

Priority rules, sequencing methods, sequence jobs through two work centers, scheduling services, application of CPM and PERT techniques.

**Reference Books:**

1. Process of Planning and Control, ChakrapaniSrinivasa

### Project

On the basis of learning in the Bachelor of Vocational, a project to be taken up by the student strengthening his/ her vocational skills

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc Automobile Servicing (AS)  
Branch Code:102**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

**Evaluation Scheme**  
**B. Voc Automobile Servicing**

<b>NSFQ Level 5 SEMESTER- I</b>											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV511	Motor Vehicle Technology -I	30	10	5	5	20	30		50	2
2	BASV512	Manufacturing Technology	30	10	5	5	20	30		50	2
3	BASV513	Automobile Electrical Equipment	30	10	5	5	20	30		50	2
4	BASV514	Two and Three Wheeler	30	10	5	5	20	30		50	2
5	BASP511	Mechanical Workshop Practice lab	30				20		30	50	1
6	BASP512	Basic Electricity and Electronics lab	30				20		30	50	1
7	BASP513	Language Lab	30				20		30	50	2
8	BAST511	Automotive Service Technician Level 5 (ASC/Q 1403)					150	Any one Training 400 hrs/ 8 weeks	150	12	
	BAST512	Spare Parts Operations Executive Level 5 (ASC/Q 1502)									
	BAST513	Industrial Engineer (Layout Design) (ASC/Q6401)									
	BAST514	Equipment Designer L5 (ASC/Q 6405)									
	BAST515	Tool Designer (ASC/Q4001)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>
<b>NSFQ Level 5 SEMESTER- II</b>											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV521	Modern Electric & Hybrid Vehicles	30	10	5	5	20	30		50	2
2	BASV522	Motor Vehicle Technology -II	30	10	5	5	20	30		50	2
3	BASV523	Material Science and Materials	30	10	5	5	20	30		50	2
4	BASV524	Garage Organization & Transport Management	30	10	5	5	20	30		50	2
5	BASV525	Project	30				20		30	50	1
6	BASP521	Electric & Hybrid Vehicles Lab	30				20		30	50	1
7	BASP522	IT Tool Lab	30				20		30	50	2
8	BASP523	Equipment Designer L5 (ASC/Q 6405)					150	Any one Training (other than 1 <sup>st</sup> sem)400 hrs/ 8 weeks	150	12	
	BAST521	Spare Parts Operations Executive Level 5 (ASC/Q 1502)									
	BAST522	Industrial Engineer (Layout Design) (ASC/Q6401)									
	BAST523	Automotive Service Technician Level 5 (ASC/Q 1403)									
	BAST524	Tool Designer (ASC/Q4001)									
<b>Total</b>										<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

NSFQ Level 6 SEMESTER- III											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV631	Automobile Electrical System	30	10	5	5	20	30		50	2
2	BASV632	Automobile Drawing & Design	30	10	5	5	20	30		50	2
3	BASV633	Automobile Engine Systems	30	10	5	5	20	30		50	2
4	BASV634	Auto Body Repair, Denting & Painting	30	10	5	5	20	30		50	2
5	BKVH631	Human Values and Professional Ethics	30	10	5	5	20	30		50	2
6	BASP631	Automobile Workshop - I	30				20		30	50	1
7	BASP632	Auto Body Repair, Denting & Painting Workshop	30				20		30	50	1
8	BAST631	Automotive Service Technician Level 6 (ASC/Q1404)					Any one Training 400 hrs/ 8 weeks	150	150	12	
	BAST632	Automation Specialist (ASC/Q6807)									
	BAST633	Assembly Line Machine Setter (ASC/Q3603)									
	BAST634	Process Design Engineer (ASC/Q6404)									
<b>Total</b>										<b>500</b>	<b>24</b>

NSFQ Level 6 SEMESTER- IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV641	Automobile Engine Systems	30	10	5	5	20	30		50	2
2	BASV642	Automotive Refrigeration and Air Conditioning	30	10	5	5	20	30		50	2
3	BASV643	Vehicle Performance and Testing	30	10	5	5	20	30		50	2
4	BASV644	Electric and Hybrid Vehicles-II	30	10	5	5	20	30		50	2
5	BKVE641	Environment and Ecology	30	10	5	5	20	30		50	2
6	BASP641	Automotive RAC Lab	30				20		30	50	1
7	BASP642	Vehicle Performance and Testing Lab	30				20		30	50	1
8	BAST641	Quality Controller (ASC/Q1605)					Any one Training (other than 3 <sup>rd</sup> sem) 400 hrs/ 8 weeks	150	150	12	
	BAST642	Automation Specialist (ASC/Q6807)									
	BAST643	Assembly Line Machine Setter (ASC/Q3603)									
	BAST644	Process Design Engineer (ASC/Q6404)									
<b>Total</b>										<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV751	Automotive System Design	30	10	5	5	20	30		50	2
2	BASV752	Alternative Fuel & Emission Control	30	10	5	5	20	30		50	2
3	BASV753	Automobile Maintenance Service & Repairs -I	30	10	5	5	20	30		50	2
4	BASV754	Auto NVH	30	10	5	5	20	30		50	2
5	BKVH751	Constitution of India, Law and Engineering	30	10	5	5	20	30		50	2
6	BASP751	Automobile Workshop - II	30				20		30	50	1
7	BASP752	Design of Automotive Systems Lab	30				20		30	50	1
8	BAST751	Spare Parts Operations In charge (ASC/Q1503)					Any one Training 400 hrs/ 8 weeks	150	150	12	
	BAST752	Body Shop In-Charge (ASC/Q1413)									
	BAST753	Service Supervisor (ASC/Q1412)									
	BAST754	Testing Manager (ASC/Q8405)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BASV761	Automobile Maintenance Service & Repairs - II	30	10	5	5	20	30		50	2
2	BASV762	Off-road Vehicles	30	10	5	5	20	30		50	2
3	BKVH761	Indian Tradition, Culture and Society	30	10	5	5	20	30		50	2
4	BASP761	Automobile Workshop - I	180						150	150	6
5	BAST761	Product Design Manager L7 (ASC/Q8103)					Any one Training (other than 5 <sup>th</sup> sem)400 hrs/ 8 weeks	200	200	12	
	BAST762	Body Shop In-Charge (ASC/Q1413)									
	BAST763	Service Supervisor (ASC/Q1412)									
	BAST764	Testing Manager (ASC/Q8405)									
<b>Total</b>			<b>670</b>							<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

**Level 5 (Semester I)**  
**Motor Vehicle Technology – 1**

**Unit1: Introduction & Chassis Layout**

General study of the motor vehicle with functions of its main components and assemblies (engine excluded), Development of a Tractor and its basic function and H.P. requirements, Conventional layout of chassis Front wheel drive, four wheel drive, rear engine vehicle, their advantages and disadvantages, Layout of Maruti car chassis and tractor chassis, Definitions of items-wheel track, wheel base, front and rear overhang, kerb weight, ground clearance.

**Unit2: Clutch System**

Layout of conventional transmission system, Maruti car transmission system, Tractor transmission system, clutch - necessity, functions, requirements, types, Constructional details and working of single plate, multiple plate, diaphragm clutches, fluid coupling, Centrifugal and semi-centrifugal clutch, Tractor clutch, Clutch pedal free play. Torque transmitted by clutch. Simple numerical problems. Clutch defects, probable causes, remedies.

**Unit3: Gear Box**

Function and necessity, Construction and working details of sliding mesh, constant mesh, synchromesh gear boxes; epicyclic gear box - its applications and advantages. Over drive, Torque convertor, Maruti-800 car gear box, tractor gear box and P.T.O. shaft, 4 wheel drive auxiliary gear box. Gear ratio

**Unit4: Final Drive**

Torque tube drive, Hotchkiss drive, Universal joints, constant velocity joints, slip joints, Propeller shaft. Differential, slip differential, double reduction differential, final drive ratio. Tractor final drive construction and working, Rear axles-Fully floating, semi-floating, three quarter floating, Tractor axles

**Unit5: Wheels and Tyres**

Road-wheels - Rim types and sizes, Tyres-conventional, radial, Tubeless tyre its advantages, Tyre sizes, wheels-front and rear, Tyre retreading, Tyre wear, wheel balancing, Tyre pressure, Advantages of filling nitrogen in tyres.

**Reference Books:**

1. Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House
2. Hillier's Fundamentals of Motor Vehicle Technology.A.W Hillier



## Manufacturing Technology

### UNIT1

(A) General Introduction: (a) Scope of subject "Workshop Technology" in engineering (b) different shop activities and broad division of the shops on the basis of nature of work done such as (i) Wooden Fabrication-carpentry (ii) Metal Fabrication (shaping and Forming, Smithy, sheet metal and Joining-welding, Riveting, Fitting and Plumbing).

GENERAL PROCESS: Classification and elementary idea of metal forming processes on the basis of the properties of deformability (Plasticity), fusibility and divisibility viz., Rolling, Forging, Drawing, Extruding, Spinning, Pressing, Punching, Blanking, Welding, Soldering, Brazing, Metal cutting processes-turning, Drilling, Boring, Shaping, Grinding, Riveting, Elementary idea of machines used for the above processes.

### UNIT2

WELDING:

(a) Welding Arcs: Definition, arc initiation, arc structures, types of arc, metal transfer characteristics and influencing parameters, weld bead geometry, various types of electrodes used in various processes.

(b) Introduction to various welding processes with procedure equipment and applications such as (i) Electric arc welding and Gas welding (ii) Resistance welding. (iii) Thermit welding (iv) Carbon arc gauging. (v) Metal-Inert-Gas welding (MIG) (vi) Tungsten Inert Gas welding (TIG)

WELDING OF SPECIAL MATERIALS: (a) Welding of carbon steel, Low alloy steel and stainless steel, equipment, filler rods, weldability, procedures and precautions. (b) Welding of Grey Cast Iron (c) Welding of Aluminium (d) Welding of Plastics.

### UNIT 3

Carpentry: (a) Fundamental of wood working operations (b) Common Carpentry Tools-Their classification, size, specification (name of the parts and use only): (i) Marking and measuring tools (ii) Holding and supporting tools: (iii) Cutting and Sawing Tools: (iv) Drilling and Boring Tools (v) Striking Tools-Mallet and Claw hammer (vi) Turning Tools & Equipment (vii) Miscellaneous Tools

PATTERN & MOULDING: The pattern materials used, Types of pattern allowances and pattern layout, Colour scheme patterns defects, Types of cores and their utility.

Elementary idea of patterns, green sand moulds and moulding, tools and equipment used in green sand moulding

### UNIT4

Moulding and Pouring: Classification of mould materials according to characteristics, Types of sands and their importance test, parting powders and liquids, Sand mixing preparation, Moulding defects

MELTING AND POURING: Brief idea of refractory material and fluxes, Fuels and metallic materials used in foundry. Melting furnaces used in foundry such as pit furnace, Tilting and cupola furnaces,

their construction and operation, metals and alloys. Additions to molten metal, Closing and pouring of the moulds, Coring-up, venting and closing, use of ladles, spur and risers, Defects due to closing and spurring, Basic idea of fettling operations. Surface treatment, Salvaging of castings, Factors determining soundness of casting.

FOUNDRY PRACTICE: Elementary idea of special casting processes-Shell mould casting, die casing, investment mould casting, centrifugal and continuous casting full mould casting. Elementary idea of mechanisation of foundries

## **UNITS**

POWDER METALLURGY: Introduction, principle, scope and names of processes. Production of metal powders, compaction, sintering and sizing, Self-lubricated bearings. Advantages of the process and its limitations (Elementary concept only)

TESTING OF WELDS & RELEVANT WELDING CODES: (a) Destructive methods-Tensile Test, Hardness Test, Fracture Test, Impact Test (b) Non destructive methods-visual, Liquid Penetrant Testing, Magnetic particles Testing, Radiographic Testing.

Advance Welding Process: Plasma Arc Welding, Laser Beam Welding, Electron Beam welding, Atomic Hydrogen arc welding, Stud welding, Explosion welding.

### **Reference Books:**

1. Workshop Technology, Vol. I: BS Raghuvanshi
2. Production Technology, Vol. I: Hazra&Chaudhry

## Automobile Electrical Equipment

### Unit 1: Automobile Wiring Systems & Cables

Earth-return and insulated-return systems; 6 Volt, 12 Volt and 24 Volt systems Positive and negative earthing. Cables-starting systems cables, general purpose cables and hightension cables; specifications and colour codes. Diagram of a typical wiring systemWiring harness, cable connectors, circuit breakers, plastic fibre-optic wires, printed circuits Fuses in circuits.

### Unit 2: Storage Battery

Principle of lead-acid cells; constructional details of battery plates, separator, container, terminal, vent plug, grouping compound. Electrolyte: specific gravity of electrolyte and its variation with temperature. Effect of charging and discharging of specific gravity, Capacity of battery Efficiency of battery, Methods of charging of battery, Internal circuit of battery charger, Care and maintenance of batteries, Checking for cell voltage and specific gravity of electrolyte, Battery tests- high discharge test, cranking motor test, open-circuit voltage test, cadmium test, life test, Battery failures, Maintenance-free batteries, VRLA batteries, Traction battery, Alkaline type batteries, Fuel cell and its types, Battery Life enhancer.

### UNIT 3: Dynamo

Principle of generation of D.C. Constructional details of a Dynamo, Armature reaction, Principle of commutation, Construction of commutator. Types of wound field generator series, shunt and compound wound, Other types of D.C. generators-four brush & four pole, interlope, split field and bucking field, Dyna-Starter, Generator drive.

### UNIT 4: Alternator

Principle of generation of A.C. Constructional details of an alternator, Working of alternators Advantages over dynamo, Types of alternators, Charging of battery with an alternator, Regulator for alternators.

### UNIT 5: Regulators

Constant current and constant voltage systems, Double-contact and compensated voltage control regulators. Current-and-voltage regulator, Cut-out

### Reference Books:

1. Automotive Electricals and Electronics, A.K. Babu, Khanna Publishing House
2. Automotive Electrical Equipment: PL Kohli
3. Modern Electrical Equipment: AW Judge
4. Automotive Electrical Equipment: WH Crouse

## **Two and Three Wheeler**

### **Unit I: The Power Unit**

Two stroke and four stroke SI & CI engine Construction and Working, merits and demerits, Symmetrical and unsymmetrical valve & port timing diagrams, scavenging process

### **Unit II: Fuel and Ignition Systems**

Fuel system – Different circuits in two wheeler fuel systems, fuel injection system. Lubrication system, Ignition systems - Magneto coil and battery coil spark ignition system, Electronic ignition System, and starting system - Kick starter system – Self starter system, recent technologies

### **Unit III: Chassis and Sub-Systems**

Main frame for two and three wheelers, its types, Chassis and different drive systems for two wheelers, Single, multiple plates and centrifugal clutches, Gear box and its and various gear controls in two wheelers. Front and rear suspension systems, Shock absorbers, Panel meters and controls on handle bar, Freewheeling devices

### **Unit IV: Brakes and Wheels**

Drum brakes & Disc brakes Construction and Working and its Types, Front and Rear brake links layouts. Brake actuation mechanism. Spoked wheel, cast wheel, Disc wheel & its merits and demerits. Tyres and tubes Construction & its Types. Steering geometry

### **Unit V: Two & Three Wheelers – Case Study**

Case study of Sports bike, Motor cycles, Scooters and Mopeds - Auto rickshaws, Pick up van, Delivery van and Trailer, Servicing and maintenance, recent developments.

### **Reference Books:**

Two and three wheeler technology, dhruv u. Panchal

## Mechanical Workshop Practice Lab

### 1. SHEET METAL WORKING AND SOLDERING:

- (EX-1) Cutting, shearing and bending of sheet.
- (EX-2) To prepare a soap case by the metal sheet
- (EX-3) To make a funnel with thin sheet and to solder the seam of the same
- (EX-4) To make a cylinder and to solder the same

### 2. FITTING SHOP WORK:

- (EX-1) Hack sawing and chipping of M.S. flat
- (EX-2) Filing and squaring of chipped M.S. job
- (EX-3) Filing on square of rectangular M.S. Plate

### 3. SMITHY SHOP WORK:

- (EX-1) To prepare square angular piece by M.S. rod
- (EX-2) To Braze M.S. flat/Tipped tool on M.S. shank
- (EX-3) To make a screw driver with metallic handle

### 4. Tin Smithy, Soldering, Brazing

- (EX-1) To prepare different types of joint such as lap joint single seam, double seam & cap joint-hem & wired edge.
- (EX-2) Utility article-waste paper basket or paper tray
- (EX-3) Study & sketch stakes / anvils.

### 5. WELDING SHOP WORK:

- (EX-1) Welding practice gas & electric
- (EX-2) Welding for lap joint after preparing the edge
- (EX-3) Welding Butt joint after preparing the edge
- (EX-4) Gas Cutting
- (EX-5) 'T' joint welding after preparation of edge.

### 6. Measurement of angle with the help of sin bar /Vernier Bevel protractor

### 7. To measure the pitch, angle and form of thread of screw.

### 8. To measure length, breadth, Thickness and depth height with micrometer height gauge and Vernier Calipers.

### 9. Calibration of Vernier Calipers/micrometersHeight gauge/depth gauge.

### 10. Use of feeler, wire radius and fillet gauge measurement of standard parameters.

### Reference Books:

1. Workshop Technology, Vol. I: Hazra&Chaudhry
2. Elements of workshop Technology Vol. I: BS Raghuwanshi

### Basic Electricity & Electronics - Lab

1. Study of series resistive circuits.
2. Study of parallel resistive circuits.
3. Study of series and parallel connection of cells in circuits.
4. Preparation of Electrolyte for lead acid battery and its charging and measurement of Specific gravity with the help of hydrometer.
5. Charging and Discharging of a capacitor.
6. Verification of magnetic field of solenoid with Iron core and Air core.
7. Verification of Torque development in a current carrying coil in magnetic field.
8. Study of R.L.C. series circuit and measurement of power and power factor.
9. Study of current and voltage measurement using Ammeter and Voltmeter.
10. Study of current and voltage measurement using Galvanometer.
11. Study of current, voltage and resistance measurement using of Multi-meter
12. Study of Power and Energy measurement using Wattmeter and Energy meter.
13. Study of working of single layer PCB manufacturing.
14. Study of working of double layer PCB manufacturing.
15. Study and interpreting circuit diagram and to check the continuity of connections.

#### Instrument Required:

1. Trainer kit for measuring TCR
2. Lead acid battery
3. Hydrometer
4. Trainer kit for measuring power and power factor in RLC circuits
5. Ammeter
6. Voltmeter
7. Multi-meter
8. Galvanometer
9. Energy Meter
10. PCB Manufacturing Facility

**Level 5 (Semester II)**  
**Modern Electric and Hybrid Vehicles**

**Unit 1:**

**Introduction**

Introduction to electric and hybrid electric vehicles, History of hybrid and electric vehicles, Social and environmental importance of electric and hybrid electric vehicles, Electrical basics, Motor and generator basics

**Unit 2:**

**Electric and Hybrid Electric Drive Trains**

Basic concept of electric and hybrid traction, Introduction to various electric and hybrid electric drive train topologies, Advantages and disadvantages

**Unit 3:**

**Power Flow**

Power flow control in electric and hybrid electric drive train topologies.

**Unit4:**

**Electric Drive Components**

Introduction to electric drive components used in electric and hybrid vehicles, Electric motor requirements, Direct Current (DC) motors (Brushed and Brushless), Power converters, Drive controllers.

**Unit 5:**

**Regenerative Braking System (RBS)**

Introduction and need of Regenerative Braking System, Advantages and disadvantages of RBS, Working of RBS, Concept of Regenerative Braking using Piezoelectric material, Using shock absorbers as vibration energy harvesters.

**Reference Books:**

1. Electric & Hybrid Vehicles, A.K. Babu, Khanna Publishing House
2. Automotive Fuel Technology-Electric, Hybrid and Fuel-Cell Vehicles: Jack Erjavec& Jeff Arias
3. Electric and Hybrid Vehicles: Design Fundamentals: Iqbal Husain
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design: Mehrdadehsani, Yimingao, AliEmadi

## Motor Vehicle Technology - II

### Unit 1:

#### Frame and Body

Function and construction of frame, Cross-section of frames, Unitized construction (monocoque) types of bodies, Terms - Turning radius, lock-to-lock angle, centre point steering, positive steering, grade ability, Idea of Safety features in a modern car.

### Unit 2:

#### Suspension System

Function, Types - conventional and independent, Spring types - coil, leaf - elliptical, semielliptical; helper springs, transverse springs, Spring camber; spring material, Torsion bar, stabiliser bar, Shock absorbers- telescopic and gas, Maruti suspension system and shockers. Anti-roll bars, Nitrox suspension.

### Unit 3:

#### Steering System And Front Axle

Principle - Ackermann and Davis, Function, requirements, Steering gear box – types, Construction and working details of worm and sector, rack and pinion, worm and wheel, worm and recirculating ball type. Tractor steering, Power steering, Electronic Steering, Front axle - rigid front axle, Stub axle, Elliot and reverse Elliot type, Lemoine and reverse Lemoine type, Tractor front axle, Maruti steering system. Wheel alignment - castor angle, camber angle, K.P.I., Toe-in, toe out. General values of these.

### Unit 4:

#### Braking System

Braking terms - braking efficiency, stopping distance, stopping time, weight transfer during braking, leading/trailing shoe of brake. Determination of braking torque, Effect of braking on steering, Types of braking systems- constructional details and working of mechanical brakes, hydraulic brakes, parking brake, vacuum, pneumatic, air-hydraulic brakes; tractor brakes, Drum and disc brakes, Master cylinder, tandem master cylinder, wheel cylinder, Brake lining and brake fluid, Brake defects, their causes and remedies, Anti Lock Braking System (ABS) & Electronic Brake Distribution (EBD).

### Unit 5:

#### Automobile Pollution And Its Control

Effects and extent of pollution caused due to stationary and automobile engines, Harmful products and their causes in petrol & diesel engines, Measures to control exhaust emissions from two-stroke engines, four-stroke engines, and diesel engines, Turbocharger, Products which cause de-activation of catalysts in catalytic converters, Unleaded petrol, Emission measuring instruments for petrol and diesel engines. Limits specified in Motor Vehicles Act. Recent trends in Automobile Pollution Control- Exhaust Gas Recirculation, Air Injection, Reactor System, Positive Crankcase Ventilation, Evaporative Emission Control System.

#### Reference Books:

1. Automobile Mechanics, A.K. Babu, S.C. Sharma, T.R. Banga, Khanna Publishing House
2. Hillier's Fundamentals of Motor Vehicle Technology. A.W Hillier

## Material Science & Materials



### **Unit 1 General:**

Brief introduction to the subject and its scope in engineering field, classification of materials of industrial importance, Their chemical thermal, electrical, magnetic, mechanical and technological properties and their selection criteria for use in industry.

### **Structure of Metals and their Deformation:**

Structure of metals and its relation to their physical, mechanical and technological properties, Elementary idea of arrangement of atoms in metals, molecular structures, crystal structures and crystal imperfections, Deformation of metals, effects of cold and hot working operations over them. Recovery re-crystallization and grain growth, solid solutions, alloys and inter metallic compounds, effect of grain size on properties of metals. PROPERTIES AND USAGE OF: (1) Metals: (a) Ferrous Metals (b) Non Ferrous Metals (2) Non-metallic Materials.

### **Unit 2**

#### **Metals-Ferrous Metals**

(a) Classification of iron and steel. (b) Cast iron types as per I.S. - White, malleable, Grey (c) Steels: Classification of steels according to carbon content and according to use as per I.S. Mechanical properties of various steels and their uses. Availability of steel in market, Its forms and specifications (d) Alloy Steel: Effect of alloying various elements, viz Cr, Ni, Co, V, W, Mo, Si, and Mn, on mechanical properties of steel, Common alloy steels, viz, Ni-steel, Ni-Cr-steel, Tungsten steel, Cobalt steel, Stainless Steel, Tool steel - High Carbon Steel, High Speed steel, Tungsten Carbide, Silicon manganese steel, Spring Steel, Heat Resisting alloy Steels etc.

### **UNIT 3:**

#### **NON-METALIC MATERIALS**

Introduction to Plastic and Other Synthetic Materials: Plastics- Important sources-Natural and Synthetic, Classification, thermo-set and thermoplastic, Various trade names, Important Properties and engineering use of plastics. Market forms of Plastics

Heat Insulating Materials: Classification of Heat Insulating material, properties and uses of China clay, Cork, Slag wool, Glass Wool, Thermocole, Puff, Properties and uses of asbestos as filler material. Hardware: General specification, uses and methods of storage of G.I. and C.I. steel, Copper, A.C. pressure conduits, R.C.C. spun, P.V.C. Pipes and their uses. General sheets specification (I.S.) and uses, Method of storage of G.I. sheets, M.S. sheets, General specification of pipe fitting

### **UNIT 4**

#### **Identification and Testing of Metal Alloys:**

Selection, specification forms and availability of materials.

#### **Heat Treatment of Metals:**

Elementary concept, purpose, Iron-carbon equilibrium diagram, T.T.T. and 'S' curve in steels and its significance, Hardening, Tempering, Annealing, Normalising and case hardening

#### **Reference Books:**

1. MATERIAL SCIENCE: RS Khurmi & RS Shedha
2. Material Science and engineering V Raghavan

### **Garage Organization & Transport Management**

## **Unit 1:**

### **Layout of garage and tools & equipment required**

Location of modern automobile garage, Layout of a fully equipped modern garage, Major equipment used in repair, testing, and reconditioning of automobiles, Service Station equipment (compressor, washer, hydraulic ramp and other lifting devices etc.)Denting and painting tools and equipment, Layout of fuel filling station-cum-service station.Workshop safety.

## **Unit 2:**

### **Garage Procedure**

A typical garage organisation chart, Duties of garage foreman, Vehicle selling- dealership, showroom, Terms of Warranty, after-sales service, advertising, and salesmanship. Diagnosing and estimating repairs. Booking of repairs, Job card, time card, Inspection and testing of repaired vehicles, Billing of repairs, Customer record, Purchase and sale of used vehicles, Insurance and accidental jobs.Safety in garages.Customer satisfaction.Time management.

## **Unit 3:**

### **Store Organisation**

Stores and store-keeping procedure.Day book, ledger, stock register.Indenting and issue of spares and materials.Inventory control.Stocking of material - shelves, racks, bins; fuels and inflammable materials.Handling of liquids and acids.Duties and responsibilities of storekeeper and purchase officer.Tools-Storing and issuing.

## **Unit 4:**

### **Fleet Management**

Types of vehicles in a fleet - goods vehicles, tankers and carriers, delivery vans, fire fighting vehicles, break-down service vehicles, buses and luxury vehicles. Layout of a fleet maintenance depot, Duties of driver, conductor and mechanic, Scheduling the maintenance of a fleet. Estimating the operating cost of transport vehicles

## **Unit 5:**

### **Motor Vehicle Act**

Definition of vehicles, testing and certifying procedures, Registration of vehicles, Permits for passenger and goods vehicles, Licensing, Transfer of ownership. Essentials of driving and traffic regulations; signals and traffic signs

### **Reference Books:**

1. Fleet Maintenance & Management: AW Clair
2. Motor Vehicle Act and Transport Management V.S.Khileri

## Project

On the basis of learning and skill acquired in the academic year, a project to be taken up by the student strengthening his/ her vocational skills

### Electric and Hybrid Vehicles Lab

1. Understand working of different configurations of electric vehicles
2. Understand hybrid vehicle configuration and its components, performance analysis
3. Understand the properties of batteries and its types
4. Understand of electric vehicle drive systems.
5. Understand of hybrid electric vehicles.
6. Understand Auxiliary systems including charging, starter motor, on board power supply, lighting and environmental sensing and conducting repairs. Repair & Replacement of Electric/ Hybrid Vehicle body
7. Repair & Replacement of Electric Vehicle Drive Train
8. Fault diagnosis & repair / replacement of Battery, DC & AC Electrical Machines, Hybrid Electric Vehicles.

### IT Tools Lab.

1. Spreadsheets, Word, Presentation
2. Multimedia Design
3. Troubleshooting
4. Project / Practical File
5. Viva Voce

## Level 6 (SEMESTER- III)

### Automobile Electrical System

#### UNIT 1:

##### Starting System

Principle, construction and working of starter motor. Series motor and its characteristics, Compound wound motor, Engine starting circuit, Starter drives-Bendix (torsion, compression), over-running clutch and sliding armature types. Starter switch - manual, solenoid, Factors affecting the starting of engines, Torque terms. Starting torque and power required, Motor efficiency, Armature reaction, typical motor specifications

#### UNIT 2:

##### Ignition System Of Spark-Ignited Engines

Types of ignition systems- battery-and-coil, magneto ignition systems, Ignition circuit, Details of the ignition system-ignition coil, distributor, condenser, contact breaker points, rotor, distributor cap, distributor drive. Firing order, Ignition timing. Ignition advance and retard, need, and factors it depends upon, Methods for obtaining advance and retard-vacuum and mechanical, Optical sensor for spark timing.

#### UNIT 3

Spark plugs-constructional details; types used in automobiles, conditions of working of spark plugs, Glow plugs of diesel engines. Magneto-rotating armature and rotating magnet types, Electronic ignition of cars & motor-cycles (CDI), Idea of Distributor-less Direct ignition system.

#### UNIT 4:

##### Lighting System

Requirements of automobile lighting, Head lamp - mounting and construction; Plastic headlamp Lens, sealed beam assembly, Asymmetrical head light, dipper and full beam, care of headlamp, Lens cleaners. Dynamic headlight beam control, Advanced Front lighting system (AFS) Types of bulbs. Reflector optics. Light sources – tungsten light Sources, tungsten halogen light sources, halogen infra-red reflective light sources, HID light sources (Xenon and bi-xenon), LED light sources, Blue vision head lamp. Auxillary lights, Brake light, Fog light, Flasher unit, warning lights and panel lights.

#### UNIT 5:

##### Accessories

Fuel and oil pressure gauge, cooling water temperature gauge, electrical speedometer, amperemeter, wind-screen wiper, electrical horn and relay, cigarette lighter, Odometer, wind-shield washing equipment, engine rpm meter, glow plug indicator, cluster assembly, Radio and television Interference suppressors, electrical switches. Central locking of doors, power winding of window panes, car heaters AC, blower and air flow controls, Rear defogger.

##### Reference Books:

1. Automotive Electricals and Electronics, A.K. Babu, Khanna Publishing House
2. Automotive Electrical Equipment: PL Kohli
3. Modern Electrical Equipment: AW Judge
4. Automotive Electrical Equipment: WH Crouse

## Automobile Drawing & Design

### Unit 1

Drafting of sectional views of the following assemblies: (a) Cylinder block and crankcase of 2-wheeler, (b) Poppet valve assembly of a 4-stroke engine, (c) Piston assembly, (d) Connecting rod assembly, (e) Spark plug, (f) Injector.

### Unit 2

Free hand line diagram of the following systems: (a) Fuel system of petrol engine (b) Fuel system of diesel engine (c) Cooling system of a multi-cylinder engine (d) Lubricating system of a multi-cylinder engine (e) Steering system of Maruti (f) Suspension systems of Maruti (g) Hydraulic Braking System of Maruti Zen (h) Air Hydraulic Braking System of TATA (i) Block diagram of Electronic Fuel Injection (EFI) system (j) Block diagram of Common Rail Direct Injection (CRDI) system (k) Oxygen sensor (l) Fuel injector of EFI.

### Unit 3

Drafting of sectional views of the following assemblies

- (1) Master cylinder
- (2) Wheel cylinder
- (3) Universal joint

### Unit 4

Sketch layouts of (a) Depot (b) F.I. pump reconditioning shop (c) Electrical Workshop.

### Unit 5

Design of the following components of an automobile engine

- (1) Piston assembly
- (2) Connecting rod assembly
- (3) Crank shaft
- (4) Flywheel

### Reference Books:

Automobile Drawing: RB Gupta

## Automobile Engine System

### UNIT1

(A) Fundamentals of Thermodynamics: Internal energy, Enthalpy, Mechanical Equivalent of Heat, Conservation of energy. First and Second Law of thermodynamics P-V diagram Reversible process Various thermodynamic processes, Entropy, General case for change of entropy of a gas. Change of entropy during various processes, Temperature-entropy diagram, Simple numerical problem

(B) Air standard cycles: Otto cycle, Diesel cycle, Air standard efficiency of Otto and Diesel cycle, Effect of compression ratio on efficiency, Simple numerical problems, Graphical representation of ideal and actual cycle, Comparison between actual and ideal cycles, Reasons for variation. Mean effective pressure, Work done during the cycle.

### UNIT2

(A) I.C. Engines' operation: Working of two stroke cycle and four stroke cycle petrol and diesel engines. Valve timing diagrams. Port timing diagrams, Classification of I.C. Engines.

(B) Reciprocating Engine Details: Construction, function, material and manufacturing process of: (a) Cylinder Block- 2-stroke air cooled and 4-stroke water cooled cylinder liner (wet and dry), cylinder head, gaskets, Different cylinder arrangements. Cylinder wear, Forms of combustion chamber in petrol engine Location of spark plug Combustion chamber in Diesel engines, Turbulence in Combustion chambers.

### UNIT3:

#### Engines Details (CONTINUED)

(b) Piston-plain, split skirt, auto-thermic, cam-ground, Anodising and Tinning of piston, Piston clearance (c) Piston rings-different types (d) Piston pin; different methods of fitting piston pin (e) Valves: Poppet, Rotary, reed, Poppet Valve arrangement, Overhead and side valve operating mechanism, Valve clearance Hydraulic tappet. Sodium cooled valves. Valve seat inserts (f) Connecting rod, Section of connecting rod Bearing metal for big and small end of connecting rod (g) Crank shaft, Left hand, right hand crankshaft, Balancing of crank shaft (General idea about static and dynamic balancing, problems excluding). Main bearings, Crankshaft end play, Vibration damper. Flywheel (h) Camshaft, Camshaft drive timing gears (i) Inlet and exhaust manifold, Mufflers, Exhaust pipe (j) Variable Valve Timing (VVT).

### UNIT4

(A) Rotary Engine. Principle and operation, Engine cooling, Advantages and limitations.

(B) Internal combustion Turbines. Principle of working, Classification, Brayton cycle, Cycle efficiency, Friction effect, Optimum compression ratio, Simple numerical problems, Deviation of practical cycles, Methods to improve efficiency, Turbine characteristics, combustion chamber, Fuel injection, Ignition Gas turbine Fuels, Materials, Turbine blades.

## UNITS

(A) Supercharging and scavenging. Necessity of supercharging, Rotary compressors, Turbocharger requirement, Effect of supercharging on power output, mechanical losses, fuel consumption, detonation, Limitations of supercharging, Methods and classification of scavenging process, Performance of different scavenging systems.

(B) Engine specifications, specifications of engines of Indian vehicles - four wheelers, three wheelers and two wheelers.

### Reference Books:

1. Automotive Engines, A.K. Babu, Khanna Publishing House
2. Thermal Engineering I & II: Sarao, Gambhir&Aggarwal
3. Automobile Engineering II: Kirpal Singh
4. Basic Automobile Engineering: CP Nakra
5. Automobile Engineering: RB Gupta

## Auto Body Repair, Denting & Painting

Safety precautions and first aid, Proper use, care and maintenance of tools and equipments  
Introduction on types, function of body and panels, Procedure for inspection, removing and refitting of body components panels, doors and other body parts, Arc welding-basic electricity and welding power source. Electrodes types, description and specification. arc welding procedure Gas welding-gas welding, brazing and soldering procedures Description of gas cutting, Resistance welding-resistance welding, process-spot, seam and butt welding Details of MIG welding, Method of fixation of wind screen, glass Procedure for cut open, beat out, dents, stripping of old paints, sanding at different stages, smooth surface preparation at different stages, putty application & primer application at different stages of affected area (chronological order for repair of auto body) fitment of repaired part and aligning to the original shape Personal safety – three key areas of risk eyes, skin and inhalation Details of personal protective, equipments-RPE, PPE Details of ingredients of paint, Procedure of refinishing process, Selection of consumable for doing painting work Procedure for doing painting (in chronological order), selection of materials, tools and equipments application of body filler for surface preparation, sanding on the affected area for smooth surface preparation, primer coating on the affected area, preparing affected surfaces for base coating, applying Base coat painting, clear coat painting for metallic paints, rubbing and polishing,  
Application of paint production, treatment/anti rust treatment Procedure for inspection of painting, work and fixing the wind screen glass Details of spray gun-types-standard air, gap design-different sizes of nozzles, Details of different types sanding - 15 equipments Different types of sand paper-grades, Possible defects in painting, objects, causes and its cure.

### Reference Books:

Automotive Body Repair & Painting Manual, John Harold Haynes



## **Automobile Workshop -I**

### **UNIT 1**

Engine tuning: Meaning and scope of engine tuning. Necessity of engine tuning, Service data of Maruti: Alto, WagonR, Swift (Petrol & Diesel); Hyundai: Santro, Ford: Figo; Volkswagen: Polo; Chevrolet: Spark. Engine analysis and tuning with the help of diagnostic computer, Diesel engine injection timing checking

### **UNIT 2**

Wheel Balance: Reasons of wheel imbalance, Effect of wheel imbalance on stability of vehicle. Static and dynamic balancing, Wheel balancing by the application of weights, Wheel Alignment: Meaning of wheel alignment, Various angles-camber, caster, KPI & toe - and their effect on steering stability, General values of popular Indian vehicles, Wheel alignment on computerised wheel aligner

### **UNIT 3**

Measurement of Exhaust Pollution by various analysers such as Four Gas Analyser, Smoke meter, Noxanalyser

### **UNIT 4**

Use of Headlight aligner, Wheel aligner, automotive oscilloscope

### **UNIT 5**

Servicing: Meaning and scope of servicing, Items attended to in servicing of a vehicle. Servicing a vehicle, Focussing and alignment of head lights

#### **Reference Books:**

1. Engine Service: Gary Lewis
2. Various Car's Manuals

## Auto Body Repair, Denting & Painting Workshop

**AUTO BODY REPAIR** Practice health & safety-familiarize, select, proper use, maintain and store – tools, equipments, Consumables clothing safety Simple basic practices on computer reading, service manuals, collision repair manuals and colour matching guide, Identification of different types of body, chassis and drive lines, Identification of location of parts and panels, Practice on operating the air compressor, Practice on periodical maintenance of air compressor Inspect and decide whether it can be repaired or replaced Remove and refit body panels, doors, floors, wheel boxes and fenders Practice on removing and refitting wind shield glasses Practice on arc welding on vehicle body Practice on gas welding, gas brazing, gas soldering and gas cutting on vehicle body Practice on resistance, spot, seam and butt welding on vehicle body Practice on MIG welding Safety precautions and first aid. Proper use, care and maintenance of tools and equipments, Introduction on types, function of body and panels Procedure for inspection, removing and refitting of body components panels, doors and other body parts Arc welding-basic electricity and welding power source. Electrodes types, description and specification, Arc welding procedure Gas welding-gas welding, brazing and soldering procedures Description of gas cutting Resistance welding-resistance welding process-spot, seam and butt welding Details of MIG welding Method of fixation of wind screen glass Procedure for cut open, beat out dents, stripping of old paints, sanding at different stages, smooth surface preparation at different stages, putty application & primer application at different stages of affected area(chronological order for repair of auto body)fitment of repaired part and aligning to the original shape, Practice on plasma welding, Practice on minor repair of auto bodycut open, beat out, strip out old paint, make smooth surface by using different grades of sanders, apply putty on affected area and applying primer(repair damaged body which is ready for final paint) Apply base coat painting, Fit check the repaired components for alignment

**AUTO BODY PAINTING** Practice health & safety-familiarize, select, proper use, maintain and store – tools, equipments, Consumables clothing safety, Practice on removing paint from the damaged area Practice on mixing and applying body filler Practice on sanding(block) Practice on mixing and applying putty Practice on applying primer Practice on feather edge sanding and masking Base coat application Surface cleaning and degreasing Second and third coat application Preheating the vehicle and cooling Cutting, scuffing, rubbing and polishing

### Reference Books:

Automotive Body Repair & Painting Manual, John Harold Haynes

**Level 6 (Semester IV)**  
**Automobile Engine Systems**

**UNIT 1**

**STARTING SYSTEM:** Idea of engine starting-system circuit Kick-starting system of 2 wheelers Starting of mopeds.

**IGNITION SYSTEM:** Idea of Battery-and-coil ignition circuit and its working, Compression ignition of diesel engines.

**LUBRICATION SYSTEM:** Lubrication in 2 stroke engines - petrol and oil-injection, Lubrication in 4 stroke multi-cylinder petrol/diesel engines, Dry and wet sump lubrication, Full pressure and semi-pressure lubrication Oil pump types, Oil pump drive, relief valve; pressure gauge. Oil filters. Full-flow and by-pass type filtering systems, Crankcase dilution, crankcase ventilation Positive Crankcase Ventilation.

Properties and functions of a good lubricating oil, Additives, Gradation of lubricating oil due to viscosity. SAE numbers, Service rating, 2T and Super 2T oils for use in 2-s engines.

**UNIT 2**

**COOLING SYSTEM:** Necessity of cooling of I.C. engines, Methods of cooling-air cooling, water cooling, liquid cooling, Shape of cooling fins Field of application of air cooling.

Water cooling system - Thermo siphon system, pump system, thermostat system of cooling Thermostat - types Radiators-different types, their construction and function Pressurized cooling system; radiator pressure-cap, surge tank Cooling water temperature gauge Anti-freeze and anti-corrosive additives Coolants Flushing of cooling system.

**AUTOMOBILE ENGINE FUELS:** Types of fuels. Influence of structure. Calorific value Requirements in fuels for I.C. engines Properties Fuel rating, Additives for S.I. and C.I. engine fuels, Specifications of petrol and diesel Leaded and un-leaded petrol, Low Sulphur diesel Enhancing Power output- Nitrox injection.

Non-conventional fuels - LPG, CNG ethanol-mixed petrol, Properties, method of manufacture and their performance as I.C. engine fuels, Engine modifications required, Dual mode engine, Idea of Electric Vehicles and Hybrid Vehicles.

**UNIT 3**

**FUEL SYSTEM OF DIESEL ENGINES:** Fuel supply system, Filters (primary and secondary); positioning of filters, Feed pump Solid and air injection system Fuel injection pump, different types- plunger, distributor pump, their construction and working, Injectors Governors Types of governing Combustion process in diesel engine, Diesel knock, Electronically Controlled Diesel Injection Pump Common Rail Direct Injection Piezoelectric effect and its use in CRDI.

**UNIT 4**

**FUEL SYSTEM OF PETROL ENGINES:** Gravity feed system used in 2-wheelers, Fuel supply circuit of 4-wheelers. Mechanical and electrical fuel pump, Electric fuel gauge, Petrol fuel filter, Air/fuel ratio, Variation of air/fuel ratio with speed, Air cleaners (wet & dry). Cyclone filter.

**CARBURETOR** - Function and principle of working of simple carburetor. Carburetor controls- throttle, choke. Types of Carburetors- fixed jet carburetor (Solex type) and constant vacuum carburetors used

in YAMAHA motorcycle, Twin-barrel carburetors, Classification of carburetors, Disadvantages of carburetors Phenomenon of combustion and detonation Pre-ignition.

## **UNIT 5**

FUEL INJECTION SYSTEMS (PETROL ENGINE): TBI, MPI; the Electronic Module, Advantages of Electronic Fuel Injection (EFI). Block diagram of the EFI, The Air Intake System and the Idle Air Control System. Fuel Delivery System. Various sensors used with the ECM, their location and purpose. Fuel Injector, Idea of Gasoline Direct Injection ENGINE PERFORMANCE AND TESTING: Various losses in an engine. Heat balance, Morse method of finding IHP, Calculation of various quantities like IHP, BHP, mechanical efficiency, thermal efficiency, relative efficiency, overall efficiency, specific fuel consumption. Performance curves.

### **Reference Books:**

Automotive Engines, A.K. Babu, Khanna Publishing House

## Automotive Refrigeration & Air-conditioning

**Unit-I: Refrigeration Fundamentals:** Introduction to refrigeration and vapour compression system, cycle diagram (Carnot cycle, Reverse Carnot cycle, Simple vapour compression cycle, bell Coleman cycle), effects of various operating parameters on performance of A/C System, Vapour absorption refrigeration system (No numerical), Applications of refrigeration and air conditioning.

**Unit-II: Refrigerants and Air Conditioning Components:** Environmental concerns/Legislation for automotive A/C systems, types and properties of refrigerants, refrigerant oils, refrigerant piping. Future refrigerants, Air conditioning components: Compressors, Condensers, flow control devices, evaporators – Design guidelines, types, sizing and their installation. Accumulators, receiver driers and desiccants, Refrigerant charge capacity determination

**Unit-III: Air distribution system:** Comfort conditions, Air management and heater systems, air distribution modes (Fresh/Recirculation, Face, Foot, Defrost, and Demist), A/C ducts and air filters. Blower fans, Temperature control systems (manual/semiautomatic, automatic). Vehicle operation modes and Cool-down performance

**Psychrometry:** Psychrometric properties, tables, charts, Psychrometric processes, Processes, Combinations and Calculations, ADP, Coil Condition line, Sensible heat factor, Bypass factor.

**Unit-IV: Load analysis and control devices:** Load Analysis, Outside and inside design consideration, Factors forming the load on refrigeration and air conditioning systems, Cooling and heating load calculations, Load calculations for automobiles, Effect of air conditioning load on engine performance, Air conditioning electrical and electronic control, pressure switching devices, sensors and actuators.

**Unit-V: Diagnostics, Trouble Shooting, Service and Repair:** Initial vehicle inspection, temperature measurements, pressure gauge reading and cycle testing, leak detection and detectors, Sight glass. Refrigerant safety/handling, refrigerant recovery; recycle and charging, system oil, system flushing, odour removal, retrofitting. Removing and replacing components, Compressor service.

### Reference Books:

Refrigeration & Air Conditioning, Sadhu Singh, Khanna Publishing House

## Vehicle Performance & Testing

**Unit-I: Vehicle Performance Parameters:** Vehicle Performance parameters: Fuel economy, acceleration, deceleration, gradability, top speed, handling, comfort, life durability, EGR systems, Impact of vehicular systems on performance: Suspension system, Steering system, Brakes, Tyres, carriage unit. Catalytic converters function and construction, Lambda close loop control system for gasoline vehicles.

**Unit-II: Drive train and Component testing:** Vehicular transmission performance: comparison of automotive clutches, Epicyclic transmission, torque converter, final drive and differential, testing of vehicle components: clutch, gear box (for noise and shifting force), brake testing, wheels and tyre testing – tyre wear pattern identification and causes.

**Unit-III: Vehicle testing:** Vehicle Testing - Road test, free acceleration test, coast down test, passer by noise test, road load data acquisition for vehicle.

Test tracks: Proving ground testing, high speed track, pavement track, corrugated track, mud track, steering pad, gradient track, deep wading through shallow water

Laboratory testing: Testing on chassis dynamometer, transition testing (Euro III onwards), accelerated testing, virtual testing, evaporative emission testing, oil consumption testing, endurance test, high speed performance test.

Collisions and Crash Testing: Crash testing: Human testing, dummies, crashworthiness, pole crash testing, rear crash testing, vehicle to vehicle impact, side impact testing, crash test sensors, sensor mounting, crash test data acquisition, braking distance test.

**Unit-IV: Comfort, Convenience and Safety:** Seats: types of seats, driving controls accessibility, and driver seat anthropometry. Steering: steering column angle, collapsible steering, and power steering. Adaptive cruise control, navigation system, adaptive noise control, driver information system, Safety: Motor vehicle safety standards, active safety, passive safety, bio-mechanics Structural safety, energy absorption, ergonomic consideration in safety.

**Unit-V: Noise Vibration and EMI:** Noise and vibration: Mechanism of noise generation, engine noise and vibration, causes and remedies on road shocks, wind noise and measurement. Automobile testing instrumentation: Sensors types and selection, instrumentation for functional tests, model test and full scale testing.

### Reference Books:

Road Vehicle Performance: Methods of Measurement and Calculation, George Gordon Lucas

## Electrical & Hybrid Vehicles – II

**Unit -I: Hybrid Architecture and Power Plant Specifications:** Series configuration locomotive drives-series parallel switching- load tracking architecture. Pre transmission parallel and combined configurations Mild hybrid- power assist- dual mode- power split- power split with shift- Continuously Variable transmission (CVT)- wheel motors. Grade and cruise targets- launching and boosting- braking and energy recuperation- drive cycle implications.

**Unit -II: Sizing the Drive System and Energy Storage Technology:** Matching electric drive and ICE; sizing the propulsion motor; sizing power electronics. Battery basics; lead acid battery; different types of batteries; battery parameters

**Unit-III: Fuel Cells:**Fuel cell characteristics- fuel cell types – alkaline fuel cell- proton exchange Membrane; direct methanol fuel cell- phosphoric acid fuel cell- molten carbonate fuel cell- solid oxide fuel cell- hydrogen storage systems- reformers- fuel cell EV- super and ultra capacitors- PEM fuel cell vehicles.

**Unit IV: Energy Storage:** Battery based energy storage: Battery basics, Lead acid (Pb-Acid) battery, Nickel-Cadmium (NiCd) battery, Nickel-Metal-Hydride (NiMH) battery, Lithium-ion (Li-ion) battery, Lithium-polymer (Li-poly) battery, Ultra capacitors.

**Unit -V: Nonelectric Hybrid Systems:** Short term storage systems flywheel accumulators, continuously variable transmissions hydraulic accumulators hydraulic pumps/motors- pneumatic hybrid engine systems operation modes.

### Reference Books:

1. Electric & Hybrid Vehicles, A.K.Babu, Khanna Publishing House
2. Impacting Rapid Hydrogen Fuel Cell Electric Vehicle Commercialization David.L. Wood

### Automotive RAC Lab.

1. Test on vapor compression test rig.
2. Test on air conditioning test rig.
3. Study of various methods of transport refrigeration systems.
4. Study and demonstration on car and bus air conditioning system.
5. Study of latest trends in automotive refrigeration systems.
6. Study and demonstration of controls in refrigeration.
7. Study of different components with the help of cut sections/models/charts- Compressor, Condenser, Evaporators, Expansion device, Blower fans, Hating systems etc.
8. Study of installation/operations/maintenance practices for refrigeration systems.
9. Study of leak testing and leak detection methods.
10. Visit to maintenance shop of automotive air conditioning and writing report on it.

### Vehicle Performance & Testing Lab

1. Estimation of power requirement for vehicle propulsion by taking actual vehicle example.
2. Perform coast down test to find vehicle inertia.
3. On road fuel consumption test at different speeds.
4. Brake efficiency measurement
5. Pass- by noise test.
6. Free acceleration test.

7. Vibration measurement in passenger compartment
8. Laboratory testing of vehicle on chassis dynamometer for performance
9. Laboratory testing of vehicle on chassis dynamometer for emission.
10. Report based on visit to vehicle testing and research organization.
11. On road emission testing of petrol and diesel vehicles for PUC/RTO.



## Level 7 (Semester V)

### Automotive System Design

#### Unit-I:

##### Design of Clutches & Gearbox:

Design requirements of friction clutches, selection criterion, torque transmission capacity, lining materials, Design of single plate clutch, multi-plate clutch and centrifugal clutch. Selection of gear ratios and final drive ratio, numerical on 3- speed and 4- speed gearbox.

#### Unit-II:

##### Design of Propeller Shafts and Axles:

Design of propeller shafts for bending, torsion and rigidity, Design of universal joints and slip joints, final drive, Design of live and dead axles.

#### Unit-III:

##### Brake Systems:

Design of hydraulic braking system, internal expanding shoe brake and disc brake, design of master and wheel cylinder and piping design.

#### Unit-IV:

##### Design of Suspension and Steering System:

General design considerations of suspension system, design of helical and leaf springs for automobile suspension system, design considerations of belleville springs, elastomeric springs, design considerations of steering system and vehicle frame design.

#### Unit-V:

##### Statistical Consideration in Design and Optimization:

Ergonomics and aesthetic design, statistics in design, design for natural tolerances, statistical analysis, and mechanical reliability, introduction to design optimization of mechanical elements, adequate and optimum design, methods of optimization, johnson's method of optimum design-simple problems in optimum design like axially loaded members.

#### Reference Books:

1. Automotive Systems Engineering, Hermann Winner, Markus Maurer
2. Automotive Mechanics – SIEWilliam Crouse

## Alternative Fuel and Emission Control

**Unit-I: Conventional Fuels and Need for alternative fuels:** Estimate of petroleum reserve and availability - comparative properties of fuels- diesel and gasoline, quality rating of SI and CI engine fuels, fuel additives for SI and CI engines, thermodynamics of fuel combustion - introduction to chemical thermodynamics, chemical reaction - fuels and combustion, enthalpy of formation and enthalpy of combustion, first law analysis of reacting systems, adiabatic flame temperature, need for alternative fuels, applications, types etc.

**Unit-II: Alternative Fuels: Gaseous Fuels and Bio-fuel:** Introduction to CNG, LPG, ethanol, vegetable oils, bio-diesel, biogas, Hydrogen and HCNG. Study of availability, manufacture, properties, storage, handling and dispensing, safety aspects, engine/vehicle modifications required and effects of design parameters performance and durability

Synthetic Fuels Introduction to Syngas, DME, P-Series, GTL, BTL, study of production, advantages, disadvantages, need, types, properties, storage and handling, dispensing and safety, discussion on air and water vehicles.

**Unit-III: Emission Control (SI Engine):** Emission formation in S.I. engines - Hydrocarbons, carbon monoxide, oxides of nitrogen, poly-nuclear aromatic hydrocarbon, effects of design and operating variables on emission formation in spark ignition engines, controlling of pollutant formation in engines exhaust after treatment, charcoal canister control for evaporative emission control, emissions and drivability, positive crank case ventilation system for ubhc emission reduction.

**Unit-IV: Emission Measurement and Control (CI Engine):**Chemical delay, intermediate compound formation, pollutant formation on incomplete combustion, effect of design and operating variables on pollutant formation, controlling of emissions, emissions and drivability, exhaust gas recirculation, exhaust after treatment – doc, dpf, scr and Int. Measurement and test procedure (ndir analyzers, fid, chemiluminescencenox analyzer, oxygen analyzer, smoke measurement, constant volume sampling, particulate emission measurement, orsat apparatus.)

**Unit-V: Health effects of Emissions from Automobiles:**Emission effects on health and environment. Emission inventory, ambient air quality monitoring, Emission Norms: As per Bharat Standard up to BS- IV.

### Reference Books:

1. Electric & Hybrid Vehicles, A.K. Babu, Khanna Publishing House
2. Engine Emissions: Pollutant Formation and Advances in Control Technology B.P. Pundir

## Automobile Maintenance Service & Repairs – I

### Unit 1:

#### Workshop Equipment

Equipment for testing electrical accessories: Electric test bench, growler, coil tester, ignition and cam-dwell-angle tester; wiring harness tester. Ampere-hour battery tester, voltmeter tester, Layout of diesel injector and F.I.P. reconditioning shop, Tools and equipment required

### Unit 2:

#### Lubrication and Maintenance Schedule

Necessity for routine maintenance, Importance of service manuals, Specification of engines- petrol and diesel vehicles

- (a) Engine (b) Clutch (c) Gear Box (d) Propeller shaft (e) Universal joints (f) Differential (g) Axles and hubs

### Unit 3:

#### Lubrication and Maintenance Schedule

- (a) Suspension system (b) Steering system (c) Tyre (d) Chassis (e) Brake-drum and disc

- (f) Battery (g) Self starter (h) Dynamo

### Unit 4:

#### Fuel System

Maintenance Schedule of diesel engine fuel injector, hot plugs, rotary and reciprocating type of fuel injection pump, fuel injection pump of single cylinder engines, hoses & pipe lines, priming unit, tanks. Electricals: Maintenance Schedule of batteries, starter motor, dynamo, ignition system, wiper motor, electrical fuel pump, alternator, horn, flasher unit.

### Unit 5:

#### Engine Tuning

- (a) Engine tuning of conventional and MPFI petrol engine. Adjustments of spark plug gap, valve tappet clearance, head bolts, Use of vacuum and compression gauge, Air cleaner cleaning, Ignition timing setting by timing light, Pollution checking, Troubleshooting

#### Reference Books:

Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House

## Automotive NVH

### Unit-I:

#### **Introduction to NVH and Vibrations:**

Noise Vibration and Harshness (NVH) and its role in automotive design and development. Physiological effects of noise and vibration, sources of vibration and noise in automobiles, Basic concepts of vibration, time period, frequency, SHM, types of vibration, Natural frequency, resonance, damping, mathematical models.

### Unit-II

#### **Vibration Control and Measurement:**

Different types of dampers, vibration absorbers, centrifugal pendulum, dry friction, untuned viscous, vibration isolation, Instruments, vibrometer, velocity pick-ups, frequency measurement instrument. one applications: isolation of the engine from vehicle structure and control of torsional oscillation amplitudes in engine crankshaft.

### Unit-III:

#### **Noise Fundamentals:**

Fundamentals of acoustics—general sound propagation—structure borne sound and air borne sound, plane wave propagation - wave equation, specific acoustic impedance, acoustic intensity, spherical wave propagation – acoustic near and far fields, reference quantities, the decibel scale

### Unit-IV:

#### **Sound Analysis:**

Anatomy of human ear, mechanism of hearing, loudness, weighting networks, equivalent sound level, relationship among sound power, sound intensity and sound pressure level.

### Unit V:

#### **Automotive Noise Sources and Control Techniques**

Methods for control of engine noise, transmission noise, intake and exhaust noise, aerodynamic noise, tyre noise, brake noise.

Noise control strategy, noise control at source – along the path isolation, damping, balancing, resonators, absorption, barriers and enclosures.

#### **Reference Books:**

1. Automotive NVH Technology (Springer Briefs in Applied Sciences and Technology), **Fuchs**, Anton, **Nijman**, Eugenius, **Priebsch**, Hans-Herwig (Eds.)

## Automobile Workshop - II

1. Find the mechanical efficiency of a multi-cylinder engine by Morse Test
2. Tune a multi-cylinder petrol engine and set dwell, rpm, ignition timing, CB point gap, spark plug gap, and tappet clearance.
3. Check the condition of the given battery as regards: (i) cell voltage (ii) specific gravity (iii) ampere-hour capacity (iv) Level of electrolyte. Use battery capacity tester. Clean the battery and charge it. Prepare a maintenance schedule.
4. Dismantle, study, assemble and check for proper working the following: (a) Electric horn (b) Wiper motor (c) Starter motor (d) dynamo (e) alternator.
5. Test the following on electrical test bench: (a) Dynamo (b) Starter motor (c) Alternator. Also study the working of a growler.
6. Dismantle, inspect and assemble the magneto of a 2-wheeler. Set the ignition timing using dial gauge.
7. Dismantle and assemble the given electrical fuel pump. Check it for proper working.
8. Set the cut-out and regulator of a vehicle.
9. Dismantle, study, and re-assemble multi-cylinder F.I. pump.
10. Test a multi-cylinder F.I. pump on calibrating machine and check it for proper phasing. Set the injection timing on the engine.
11. Test a diesel fuel injector and set injection pressure. Grind needle and seat.
12. Study and sketch rotary F.I. pump.
13. Study of working of electric vehicle.
14. Study and sketch the Electrical Wiring System of a Car.

## Design of Automotive Systems Lab

1. Design of automotive clutch assembly and component drawing using any drafting software (Two full imperial sheets along with design calculations report) consists of:
  - Functional design of clutch
  - Design of clutch shaft, hub and flange
  - Design of damper springs
  - Design of sectors, rivets etc.
  - Design of pressure plate assembly
  - Design for linkage mechanism
  - Details and assembly drawing
  - Details and assembly drawing
2. Design of automotive gear box along with reverse gear (Two full imperial sheets along with design calculations report) consists of:
  - Calculation of gear ratios
  - Determination of number of teeth on gear pair
  - Determination of gear reductions
  - Design of gear pairs
  - Design of shafts
  - Selection of bearings
  - Details and assembly drawing
3. Design of suspension spring and its analysis using any analysis software.

## Automobile Maintenance Service & Repairs – I

### Unit 1:

#### Workshop Equipment

Equipment for testing electrical accessories: Electric test bench, growler, coil tester, ignition and cam-dwell-angle tester; wiring harness tester. Ampere-hour battery tester, voltmeter tester, Layout of diesel injector and F.I.P. reconditioning shop, Tools and equipment required

### Unit 2:

#### Lubrication and Maintenance Schedule

Necessity for routine maintenance, Importance of service manuals, Specification of engines- petrol and diesel vehicles (a) Engine (b) Clutch (c) Gear Box (d) Propeller shaft (e) Universal joints (f) Differential (g) Axles and hubs

### Unit 3:

#### Lubrication and Maintenance Schedule

(a) Suspension system (b) Steering system (c) Tyre (d) Chassis (e) Brake-drum and disc (f) Battery (g) Self starter (h) Dynamo

### Unit 4:

#### Fuel System

Maintenance Schedule of diesel engine fuel injector, hot plugs, rotary and reciprocating type of fuel injection pump, fuel injection pump of single cylinder engines, hoses & pipe lines, priming unit, tanks. Electricals: Maintenance Schedule of batteries, starter motor, dynamo, ignition system, wiper motor, electrical fuel pump, alternator, horn, flasher unit. Unit 5: Engine Tuning (a) Engine tuning of conventional and MPFI petrol engine. Adjustments of spark plug gap, valve tappet clearance, head bolts, Use of vacuum and compression gauge, Air cleaner cleaning, Ignition timing setting by timing light, Pollution checking, Troubleshooting

#### Reference Books:

1. Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House
2. Automotive Technology:Service And Maintenance Don Knowles

## Off-Road Vehicles

### Unit 1:

#### Classification and Requirements of Off Road Vehicles

Introduction, pretest, history and overview of an off-road machines, construction layout, capacity and applications, power plants, chassis and transmission, multi-axle vehicles

### Unit 2:

#### Earth Moving Machines

Different types of earth moving equipments and their applications. Bulldozers, cable and hydraulic dozers, Crawler track, running and steering gears, scrapers, drag and self powered types - Dump trucks and dumpers - Loaders, single bucket, multi bucket and rotary types - Power and capacity of earth moving machines.

### Unit 3:

#### Farm Equipments & Tractors

Scrapers, elevating graders, motor graders, self powered scrapers and graders, power shovel, revolving and stripper shovels, drag lines, ditchers, capacity of shovels Tractors: General description, specification and functions, light, medium and heavy wheeled tractors, crawler tracks mounted / wheeled-bull dozers, tilt dozers and angle dozers, front end loaders, factors affecting efficiency of output of tractors, simple problems, merits and demerits

### Unit 4:

#### Combat Vehicles and Vehicle Systems

Power take off, special implements. Special features and constructional details of tankers, gun carriers and transport vehicles Vehicle Systems: Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics, Hydro-pneumatic suspension cylinders, Power steering system, Kinematics for loader and bulldozer operational linkages, Safety features, safe warning system for dumper, Design aspects on dumper body, loader bucket and water tank of sprinkler

### Unit 5:

#### Vehicle Evaluation Mobility

Soil-Vehicle Mechanics, characteristics of soils, nominal ground pressure, mean maximum pressure, the mobility index (mi), vehicle cone index (vci) and rated cone index (rci), mobility number, dynamic behavior and traction on wet soil, traction performance and factors affecting traction performance

#### Reference Books:

1. Off-road Vehicle Dynamics: Analysis, Modelling and Optimization Hamid, ArefMardani
2. Road and Off-Road Vehicle System, Manfred Ploechl
3. Off-Road Vehicles, Ian Graham

### Project

On the basis of learning in the B.Voc. Programme, i.e. Level 5 to Level 7, a project to be taken up by the student strengthening his/ her vocational skills



**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY UTTAR  
PRADESH, LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc  
Production Technology (PT)  
Branch Code: 103**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

**Evaluation Scheme**  
**B. Voc Production Technology**

<b>NSFQ Level 5 SEMESTER- I</b>											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV511	Machine Tool Technology	30	10	5	5	20	30		50	2
2	BPTV512	General Mechanical Engineering-I	30	10	5	5	20	30		50	2
3	BPTV513	Production Technology	30	10	5	5	20	30		50	2
4	BPTV514	Metrology and Measuring Instruments	30	10	5	5	20	30		50	2
5	BPTP511	Metrology and Measuring Instruments Lab	30				20		30	50	1
6	BPTP512	Machine Tool Technology Lab	30				20		30	50	1
7	BPTP513	Language Lab	30				20		30	50	2
8	BPTT511	Metal Arc Welding (CSC/Q0204)						Any one Training 400 hrs/ 8 weeks		150	12
	BPTT512	MIG MAG or GMAW Welder (CSC/Q0209)									
	BPTT513	Assistant TIG Welder (CSC/Q0212)									
	BPTT514	CNC Setter Cum Operator (CSC/Q0120)									
	BPTT515	CNC Operator – VMC (CSC/Q0116)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>
<b>NSFQ Level 5 SEMESTER- II</b>											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV521	Industrial Management	30	10	5	5	20	30		50	2
2	BPTV522	Manufacturing Technology	30	10	5	5	20	30		50	2
3	BPTV523	Material Science and Materials	30	10	5	5	20	30		50	2
4	BPTV524	General Mechanical Engineering-II	30	10	5	5	20	30		50	2
5	BPTP521	Project	30				20		30	50	1
6	BPTP522	Basic Electricity and Electronics Lab	30				20		30	50	1
7	BPTP523	Mechanical Workshop Practice Lab	30				20		30	50	2
8	BPTT521	Metal Arc Welding (CSC/Q0204)					150	Any one Training (other than 1 <sup>st</sup> sem)400 hrs/ 8 weeks		150	12
	BPTT522	MIG MAG or GMAW Welder (CSC/Q0209)									
	BPTT523	Assistant TIG Welder (CSC/Q0212)									
	BPTT524	CNC Setter Cum Operator (CSC/Q0120)									
	BPTT525	CNC Operator – VMC (CSC/Q0116)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

NSFQ Level 6 SEMESTER- III											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV631	Metal Casting Technology	30	10	5	5	20	30		50	2
2	BPTV632	Production Automation & Computer Integrated Mfg.	30	10	5	5	20	30		50	2
3	BPTV633	Fundamental of Mechatronics	30	10	5	5	20	30		50	2
4	BPTV634	Machining and Machine Tools	30	10	5	5	20	30		50	2
5	BKVVH631	Human Values and Professional Ethics	30	10	5	5	20	30		50	2
6	BPTP631	Metal Casting Technology Workshop	30				20		30	50	1
7	BPTP632	Mechatronics Lab	30				20		30	50	1
8	BPTT631	Service Engineer – Installation (CSC/Q0501)					Any one Training 400 hrs/ 8 weeks	150		150	12
	BPTT632	Quality Inspector – Forged, Casted or Machined Component (CSC/Q0601)									
	BPTT633	CNC Programmer (CSC/Q0401)									
	BPTT634	Maintenance Fitter – Mechanical (CSC/Q901)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>
NSFQ Level 6 SEMESTER- IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV641	Mass Production Devices	30	10	5	5	20	30		50	2
2	BPTV642	Agile and Lean Manufacturing	30	10	5	5	20	30		50	2
3	BPTV643	Metal Forming Processes	30	10	5	5	20	30		50	2
4	BPTV644	Non-Conventional Machining	30	10	5	5	20	30		50	2
5	BKVE641	Environment and Ecology	30	10	5	5	20	30		50	2
6	BPTP641	Tool and Die Making Lab	30				20		30	50	1
7	BPTP642	IT Tool Lab	30				20		30	50	1
8	BPTT641	Service Engineer – Installation (CSC/Q0501)					Any one Training (other than 3rd sem) 400 hrs/ 8 weeks	150		150	12
	BPTT642	CNC Programmer (CSC/Q0401)									
	BPTT643	Quality Inspector – Forged, Casted or Machined Component (CSC/Q0601)									
	BPTT644	CNC Setter Cum Operator – VMC (CSC/Q0123)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

GV: General Vocational; VP: Vocational Practical; OJT: On Job Training; SSC: Sector Skill Council

NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV751	Reliability ,Maintenance & Safety Engineering	30	10	5	5	20	30		50	2
2	BPTV752	Plant Layout and Product Handling	30	10	5	5	20	30		50	2
3	BPTV753	Product Design and Manufacturing	30	10	5	5	20	30		50	2
4	BPTV754	CAD & CAM	30	10	5	5	20	30		50	2
5	BKVH751	Constitution of India, Law and Engineering	30	10	5	5	20	30		50	2
6	BPTP751	CAD Lab	30				20		30	50	1
7	BPTP752	CAM Lab	30				20		30	50	1
8	BPTT751	Tool & Die Maker (CSC/Q0306)					Any one Training 400 hrs/ 8 weeks	150	150	12	
	BPTT752	Designer – Mechanical (CSC/Q0405)									
	BPTT753	Service Engineer – Breakdown Service (CSC/Q0503)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV761	Rapid Prototyping and Reverse Engineering	30	10	5	5	20	30		50	2
2	BPTV762	Production Planning and Control	30	10	5	5	20	30		50	2
3	BKVH761	Indian Tradition, Culture and Society	30	10	5	5	20	30		50	2
4	BPTP761	Major Project	180						150	150	6
5	BPTT761	Tool & Die Maker (CSC/Q0306)					Any one Training (other than 5 <sup>th</sup> sem)400 hrs/ 8 weeks	200	200	12	
	BPTT762	Designer – Mechanical (CSC/Q0405)									
	BPTT763	Service Engineer – Breakdown Service (CSC/Q0503)									
<b>Total</b>			<b>670</b>							<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

## Level 5 (Semester I) Machine Tool Technology

### Unit 1: Centre Lathe

The centre lathe and its principle of working, Types of lathes, Lathe specification and size, Features of lathe bed, Head stock and tail stock, feed mechanism and change-gears. carriage saddle, Cross slide, Compound rest, Tool post, Apron mechanism, lathe accessories, Chucks, Face plate, Angle plate, Driving plate, Lathe doges, mandrils, Steady rest, Lathe attachments, Lathe operations-plane and step turning, Taper turning, Screw cutting, Drilling, Boring, reaming, Knurling, Parting off, Under cutting, Relieving, Types of lathe tools and their uses, Brief description of semi-automatic lathes such as capstan and turret lathes, their advantages and disadvantages over centre lathe, types of job done on them. General and periodic maintenance of a centre lathe

### Unit 2: Shaping, Planing & Slotting Machines

Working principles of planer, shaper and Slotter, Differences and similarities among them, quick return mechanism applied to the machines. Types of work done on them, types of tools used, their geometry, General and periodic maintenance of a shaper.

DRILLING & BORING MACHINES: Types of tools used in drilling and boring. Classification of drilling and boring machines, principle of working and constructional details of simple and radial drilling M/C and general and periodic maintenance. Operations like facing, counter boring, tapering.

### Unit 3: Milling Machines

Types of milling machines, constructional features of horizontal milling M/C. general maintenance of the machine, types of milling cutters, milling operations like plane milling, space milling, angular milling form milling, straddle milling, gang milling, Negative rake milling, cutting speed and speed for different tools in up and down milling. Simple, compound and differential indexing, milling of spur gears and racks

### Unit 4: Grinding Machines

Common abrasives, grinding wheel materials, Bonds, Grain and grit of abrasive, Grain structure and shapes of common wheels, various speeds and feeds, Use of coolants, Methods of grinding, Types of grinding machines, precision finishing operations like honing.

BROACHING MACHINES: Types of work done on broaching machine. Simple types of broaches and their uses, Types of broaching machines

### Unit 5: Jigs and Fixtures

Object of Jigs and Fixture, Difference between jigs and fixtures, Principle of location, Principle of clamping, Locating and clamping devices. Types of jigs -Simple open and closed (or box) jigs. Drill jigs-bushes (Fixed, Liner, Renewal, and Slip). Template, Plate jigs. Channel jigs, Leaf jigs, Simple example of milling, turning, grinding, horizontal boring fixtures and broaching fixtures. Welding fixtures

COOLING PROCESS: Cooling and cutting fluids, difference between coolant and cutting fluid, function and action of cutting fluids, Requirement of good cutting fluids, their selection for different materials and operations  
AUTOMATION OF MACHINE TOOLS: Introduction to CNC lathe (Computer Numerical Control Lathe) and FMS (Flexible Manufacturing System) Introduction only.

### Reference Books:

1. Production Technology: Jain & Gupta
2. Workshop Technology Vol. II: Hazra & Choudhary

## General Mechanical Engineering – I

### Unit 1: Strength of Materials & Power

#### Transmission

Stress, strain, elastic constraints, stress in circular shaft subjected to pure torsion only, Riveted and bolted joints.

#### Unit 2: Shear Force & Bending Moment

Elementary idea of Shear force and bending moment for concentrated, uniformly distributed loads on simply supported beam cantilever and overhanging beam, Simple Shear force and bending moment diagrams, Relationship between shear force and bending moment

#### Unit 3: Power Transmission: Pulleys, Gears & Shaft

Classification of Pulleys, Types of Belts, Simple calculation of pulley diameter, Classification of Gears, Simple calculation of number of teeth and speed, Power transmission by solid and hollow shaft

#### Unit 4: Hydraulics & Hydraulic Machines

Properties of fluids, pressure of fluid and its measurement. Flow of fluids, velocity and discharge, Bernoulli's theorem and its application in venturimeter, flow through pipe, head loss due to friction

#### Unit 5: Water Turbines & Pumps

Capacity & Working of Turbines- Pelton and Reaction, reciprocating and centrifugal pump

#### Reference Books:

1. Basic Mechanical Engineering, M.P. Poonia & S.C. Sharma, Khanna Publishing House
2. Strength of Materials, D.S. Bedi, Khanna Publishing House

## Production Technology

### Unit 1

**Production Machine Tools:** Machine tools used for quantity production, semi-automatic multi tools centre lathe. Auto-lathes, sliding head types, Single spindle automatics, Multi-spindle automatics, Mechanical copying systems, Hydraulic servo copying systems for lathe, Electric copying systems.

**TRANSFER MACHINES:** Types of productions. Types of layout, Economic justification of transfer machines, Inline transfer, drum type transfer machines. Automatic loading & Transferring methods, Machining heads, Automatic inspections, Tool servicing, Transfer press linked lines.

### Unit 2

**Generation Of Forms:** Forming 'V' generating. Thread chasing. Die heads. Threadrolling. Thread milling. Thread grinding. Gear planning, Gear shaping, Gear hobbing, Straight Bevel Gear Manufacture. Spiral bevel Gear Manufacture.

### Unit 3

**Surface Treatment & Finishing:** Meaning of the terms surface treatment and its purpose, Elements of surface treatment cleaning protecting, Colouring, Altering surface properties.

Surface Treatment Processes- Wire brushing, Belt sanding, Alkaline cleaning, Vapour degreasing, Pickling, Latest trends in Surface preparation, Ultrasonic cleaning, Solvent cleaning, Painting application by dipping, Hand spraying, Automatic spraying, Electrostatic spray finishing. Electro-coating, Hot dip coating, phosphate coating- Packerising and bonderasing, Buffing, Blackening, Anodising. Electro Nickle Plating, Nickle carbide plating, Sputtering, Automation in Painting,

**AUTO CONTROL OF SIZE:** Auto sizing, Mechanical calliper for turning operation, Pneumatic sizing of external cylindrical ground work, Pneumatic slide position measuring device, Digital slide position measuring device, Auto sizing device for centre-less grinding operation. Friction rollers, Optical measurement

### Unit 4

**Cutting Tools For Machining:** Elements of machining process, Single point tools -Basic angles, Chip formation, Effect of manipulating factors such as velocity, size of cut, effect of tool geometry, Tool material, Cutting fluids and contamination in them, Work piece material, Tool life model, Machining economics, Specific power consumption

Basic principles of multipoint tools, Linear travel tools, Broaches, Gear shaper cutters, Axial feed rotary tools-Twist drill, Reamers, Core drills, Counter bores and counter sinks, Multiple diameter tools, Hobs, Characteristics of tools materials, Tool materials, Tool steels, High speed steel, Cast cobalt alloys. Carbides or cintered carbide, Ceramics, Carbide tools

Surface treatment of cutting tools- Its advantage, Tin coated high speed steel diamonds. Cubic boron nitrides, Specialised knowledge of steel cutting

### Unit 5

**Press Tools:** Factors affecting press tool design, Shearing, Bending, Drawing, combination tools, Progression tools, Rubber die formatting, high energy forming, Explosive forming  
**SPECIFICATION OF QUALITY & RELIABILITY:** Quality, Specification Designing for production Standardisation, Preferred numbers, Limits and fits, Tolerance build up, Geometric tolerances. Limit gauging

### Reference Books:

- (i) Production Engineering: PC Sharma
- (ii) Production Technology: CK Singh

## Metrology and Measuring Instruments

## Unit 1

**Introduction:** Meaning and scope of metrology in field of engineering, Standards and types of measurements (Line and Wave, length, Primary, Secondary and Tertiary measurement concept only). Limits, Fits and Tolerances, Interchangeability, precision and accuracy, Sources of error

**PRINCIPLES AND CLASSIFICATIONS OF MEASURING INSTRUMENTS:**

- (i) Principle of Mechanical Measuring Instruments: Lever method, Vernier method, screw and screw nut method, compound gearing and helical spring methods.
- (ii) Principles of Optical Instruments: Reflection, Refraction, Interference, Polarisation, Optical prisms, Lenses and Optical projectors.
- (i) Principles of Electrical measuring Instruments.
- (ii) Principles of Hydraulic and Pneumatic Instruments.

## Unit 2:

### Comparators

General principles of constructions, balancing and graduation of measuring instruments, characteristics comparators, use of comparators, difference between comparators, limit gauges and measuring instruments. Classification of comparators, construction and working of dial indicator, mechanical comparator, mechanical-optical, zeissoptotest, electro limit, electromechanical electronics, pneumatic comparators, gauges, tool makers microscope.

## Unit 3:

### Surface Finish

Geometrical characteristics of surface roughness- Wavyness, layflaws, Effect of surface quality on its functional properties. Factor affecting the surface finish, Drafting symbols for surface roughness, Evaluation of surface finish RMS and CLS values, Methods of measuring surface roughness qualitative and quantitative methods, Comparison of surface produce by common production methods.

## Unit 4

### Various Types of Instruments Used For:

1. (a) Physical Measurements such as-Length, distance, height, Thickness, Gaps, Curvature, Angle, Taper, Area, Undulations, Surface finish, Thread and Gear measurement (b) Liquid Level & Viscosity- Liquid level measuring methods and devices, Viscometer - Plate and cone Viscometer, Two float viscometer, Rheo viscometer
2. Mechanical Quantities: (a) Displacement. velocity, acceleration, space torque-Use of transducers and electronic count stroboscope, vibrating reeds and technometers (b) Pressure and Vacuum - Idea of atmosphere pressure, Gauge pressure and vacuum - Use of instruments such as manometers and those use elastic elements such as diaphragm, capsule Bellows, Bourdon tube and various transducers thermo couple, vacuum gauges (c) Strain - Use of Strain gauge and load cells (d) Mechanical Power - Dynamometers - absorption and transmission type both. (Reference Only)

TEMPERATURE MEASUREMENT: Various types of thermometers, thermocouples, pyrometers (Radiation and optical type both)

## Unit 5



**Inspection of Geometrical Errors:**

Construction and working of auto collimeter, checking of straightness, flatness, squareness and parallelism, circularity (By dial gauge and telerod).

Maintenance Of Measuring Instruments: Defects likely to occur in measuring instruments and their remedies. General maintenance of measuring instruments

**Reference Books:**

1. Metrology: RK Jain
2. Mechanical Measurement: RK Jain

### **Metrology and Measuring Instruments lab.**

#### **Bridge Course to be merge with practical classes:**

Introduction of scale, orthographic projection, simple drawing of mechanical components, and cut sections, significance of various types of lines used in engineering drawing, representation of material, brief idea of isometric projections

Types of thread, single start, multi start thread and their application

1. Measurement of angle with the help of sine bar/ Vernier Bevel protractor.
2. Study and sketch of various types of optical projectors.
3. Study and sketch of various types of comparators and use them for comparing length of given piece.
4. To measure the diameter of a hole with the help of precision balls.
5. To measure external and internal taper with the help of taper gauges, precision rollers.
6. To test the squareness of a component with auto-collimeter.
7. To measure the pitch, angle and form of thread of a screw.
8. To measure the geometry of a gear having involute profile.
9. To measure the straightness of the edge of a component with the help of auto-collimeter.
10. To measure the length, breadth, thickness, depth, height with micrometer.
11. To measure the length, breadth, thickness, depth, height, with height gauge and Vernier calipers.
12. Calibration of Vernier calipers/micrometers.
13. Calibration of height gauge/depth gauge.
14. Study of a tool maker's microscope.
15. Checking of accuracy of snap gauge with slop gauge.
16. Checking of accuracy of a plug gauge with micrometer.
17. Measurement of areas by polar planimeter.
18. Use of feeler, wire, radius and fillet gauges measurement of standard parameters.

### **Machine Tool Technology Lab.**

#### **(A) MACHINE SHOP**

1. (a) Square thread cutting (internal and external) - 2 jobs
  - (b) Multi-start thread cutting - 1 job
  - (c) Eccentric Turning - 1 job
2. Making utility job - Planner, Shaper, Slotter - 1 job
3. Group work on milling machine involving up & down milling in:
  - (a)Gang milling - 1 job
  - (b)Spur gear cutting - 1 job
  - (c)Helical gear cutting - 1 j

#### **(B) FITTING SHOP**

1. To make a cut and cup tool - 1 job
2. To make blank and pierce tool - 1 job
3. To make a male and female fitting jobs - 1 job
4. To grind a lathe/shaper/planer tool - 1 job
5. To make different types of keys - 3 jobs
6. To make complete gauge - 2 jobs

**Level 5 (Semester II)**  
**Industrial Management**

**Unit 1**

**Introduction**

Growth of industry, The management of men, materials and machines, the art of management, Sources of capital- industrial individual enterprise, private partnership and private Ltd. Co., Joint Stock Co. shares, debentures, financial agencies and their role in promoting industries. Break even analysis.

**Unit 2**

**Private sector and public sector:**

Public sector enterprise, merits and demerits of public sector industry and private sector industry, Line, staff and functional organizations, reasons for the choice of various types of organization, functions of different departments, viz. stores, purchase and sales departments relationship between individual departments.

**Unit 3**

**Wages & incentives**

Definition of wages, real wage and nominal wage, systems of wage payment, incentives, financial and non - financial incentives, Essentials of a good wage plan, essentials of a good incentive scheme. Introduction to elements of cost & indirect expenses, Material cost, labour cost, fixed and variable overheads, components of cost, selling price, Factory expenses, administrative expenses, selling & distribution expenses, depreciation, obsolescence, interest on capital, Idleness, Repair and maintenance.

**Unit 4**

**Labour, industrial & tax laws:**

Evolution of industrial law, factory act, workmen compensation act, payment of wages act, employee's state insurance act, Industrial dispute act. Role of technician in industry: Position of technician in various engineering departments, Role of a supervisor in industry, Foremanship, duties and qualities of a good foreman.

**Unit 5**

**Material management:**

Introduction, Scope of Material Management selective control techniques-ABC analysis, Material handling, inventory control, Essential steps in inventory control, quality standards.

**Reference Books:**

1. Industrial Engineering and Management, S.C. Sharma, Khanna Publishing House
2. Industrial Safety, S.C. Sharma, Khanna Publishing House
3. Industrial Engineering & Management: Banga, Sharma & Agrawal
- 4 .Industrial Engineering Safety & Pollution (Hindi): HemendraDutt

## Manufacturing Technology

### Unit 1

(A) General Introduction: (a) Scope of subject "Workshop Technology" in engineering (b) different shop activities and broad division of the shops on the basis of nature of work done such as (i) Wooden Fabrication-carpentry (ii) Metal Fabrication (shaping and Forming, Smithy, sheet metal and Joining-welding, Riveting, Fitting and Plumbing).

GENERAL PROCESS: Classification and elementary idea of metal forming processes on the basis of the properties of deformability (Plasticity), fusibility and divisibility viz., Rolling, Forging, Drawing, Extruding, Spinning, Pressing, Punching, Blanking, Welding, Soldering, Brazing, Metal cutting processes-turning, Drilling, Boring, Shaping, Grinding, Riveting, Elementary idea of machines used for the above processes.

### Unit 2

WELDING:

(a) Welding Arcs: Definition, arc initiation, arc structures, types of arc, metal transfer characteristics and influencing parameters, weld bead geometry, various types of electrodes used in various processes.

(b) Introduction to various welding processes with procedure equipment and applications such as (i) Electric arc welding and Gas welding (ii) Resistance welding. (iii) Thermit welding (iv) Carbon arc gauging. (v) Metal-Inert-Gas welding (MIG) (vi) Tungsten Inert Gas welding (TIG)

WELDING OF SPECIAL MATERIALS: (a) Welding of carbon steel, Low alloy steel and stainless steel, equipment, filler rods, weldability, procedures and precautions. (b) Welding of Grey Cast Iron (c) Welding of Aluminium (d) Welding of Plastics.

### Unit 3

Carpentry: (a) Fundamental of wood working operations (b) Common Carpentry Tools-Their classification, size, specification (name of the parts and use only): (i) Marking and measuring tools (ii) Holding and supporting tools: (iii) Cutting and Sawing Tools: (iv) Drilling and Boring Tools (v) Striking Tools-Mallet and Claw hammer (vi) Turning Tools & Equipment (vii) Miscellaneous Tools

PATTERN & MOULDING: The pattern materials used, Types of pattern allowances and pattern layout, Colour scheme patterns defects, Types of cores and their utility.

Elementary idea of patterns, green sand moulds and moulding, tools and equipment used in green sand moulding

### Unit 4

Moulding and Pouring: Classification of mould materials according to characteristics, Types of sands and their importance test, parting powders and liquids, Sand mixing preparation, Moulding defects

MELTING AND POURING: Brief idea of refractory material and fluxes, Fuels and metallic materials used in foundry. Melting furnaces used in foundry such as pit furnace, Tilting and cupola furnaces, their construction and operation, metals and alloys. Additions to molten metal, Closing and pouring of the moulds, Coring-up, venting and closing, use of ladles, spur and risers, Defects due to closing and spurring, Basic idea of fettling operations. Surface treatment, Salvaging of castings, Factors determining soundness of casting.

FOUNDRY PRACTICE: Elementary idea of special casting processes-Shell mould casting, die casing, investment mould casting, centrifugal and continuous casting full mould casting. Elementary idea of mechanization of foundries

### **Unit 5**

POWDER METALLURGY: Introduction, principle, scope and names of processes. Production of metal powders, compaction, sintering and sizing, Self-lubricated bearings. Advantages of the process and its limitations (Elementary concept only)

TESTING OF WELDS & RELEVANT WELDING CODES: (a) Destructive methods-Tensile Test, Hardness Test, Fracture Test, Impact Test (b) Nondestructive methods-visual, Liquid Penetrant Testing, Magnetic particles Testing, Radiographic Testing.

Advance Welding Process: Plasma Arc Welding, Laser Beam Welding, Electron Beam welding, Atomic Hydrogen arc welding, Stud welding, Explosion welding.

### **Reference Books:**

1. Workshop Technology, Vol. I: BS Raghuvanshi
2. Production Technology, Vol. I: Hazra & Chaudhry

## Material Science & Materials

### Unit 1

#### General:

Brief introduction to the subject and its scope in engineering field, classification of materials of industrial importance. Their chemical thermal, electrical, magnetic, mechanical and technological properties and their selection criteria for use in industry.

#### STRUCTURE OF METALS AND THEIR DEFORMATION:

Structure of metals and its relation to their physical, mechanical and technological properties, Elementary idea of arrangement of atoms in metals, molecular structures, crystal structures and crystal imperfections, Deformation of metals, effects of cold and hot working operations over them. Recovery re-crystallization and grain growth, solid solutions, alloys and inter metallic compounds, effect of grain size on properties of metals. PROPERTIES AND USAGE OF: (1) Metals: (a) Ferrous Metals (b) Non Ferrous Metals (2) Non-metallic Materials.

#### Unit 2:

##### Metals-Ferrous Metals

1. Classification of iron and steel. (b) Cast iron types as per I.S. - White, malleable, Grey (c) Steels: Classification of steels according to carbon content and according to use as per I.S. Mechanical properties of various steels and their uses. Availability of steel in market, Its forms and specifications (d) Alloy Steel: Effect of alloying various elements, viz Cr, Ni, Co, V, W, Mo, Si, and Mn, on mechanical properties of steel, Common alloy steels, viz, Ni-steel, Ni-Cr-steel, Tungsten steel, Cobalt steel, Stainless Steel, Tool steel - High Carbon Steel, High Speed steel, Tungsten Carbide, Silicon manganese steel, Spring Steel, Heat Resisting alloy Steels etc.

#### Unit 3:

##### Non-Metallic Materials

Introduction to Plastic and Other Synthetic Materials: Plastics- Important sources-Natural and Synthetic, Classification, thermo-set and thermoplastic, Various trade names, Important Properties and engineering use of plastics. Market forms of Plastics

Heat Insulating Materials: Classification of Heat Insulating material, properties and uses of China clay, Cork, Slag wool, Glass Wool, Thermocole, Puff, Properties and uses of asbestos as filler material.

Hardware: General specification, uses and methods of storage of G.I. and C.I. steel, Copper, A.C. pressure conduits, R.C.C. spun, P.V.C. Pipes and their uses. General sheets specification (I.S.) and uses, Method of storage of G.I. sheets, M.S. sheets, General specification of pipe fitting

#### Unit 4

IDENTIFICATION AND TESTING OF METAL ALLOYS: Selection, specification forms and availability of materials.

HEAT TREATMENT OF METALS: Elementary concept, purpose, Iron-carbon equilibrium diagram. T.T.T. and 'S' curve in steels and its significance, Hardening, Tempering, Annealing, Normalising and case hardening

#### Reference Books:

Material Science: RS Khurmi & RS Shedha

## General Mechanical Engineering - II

### Unit 1:

#### Basics of Thermodynamics

Basic definition of heat, work, Thermodynamic process, parameters of working body and their units, Equation of state, Universal gas constant, Relation between heat capacity and temperature. Determination of quantity of heat

### Unit 2:

#### Laws of Thermodynamics

Elementary concept of laws of thermodynamics, first law and second law, Graphical representation of process, The work of expansion and compression of a gas, Change in the state of ideal gas-Isochoric, Isothermal and Adiabatic process, Carnot-cycle

### Unit 3:

#### IC Engines

External & internal combustion engines, working of diesel and petrol engine, horse power of IC engines,

### Unit 4:

#### Steam Generators & Condensers

Construction and working of Babcock & Wilcox boiler, Cochran boiler, Steam condenser & its types

### Unit 5: Steam & Gas Turbines

Steam turbine, classification and principle of operation, gas turbine

#### Reference Books:

1. Basic Mechanical Engineering, M.P. Poonia & S.C. Sharma, Khanna Publishing House
2. Strength of Materials, D.S. Bedi, Khanna Publishing House
3. General Mechanical Engineering: Jk Kapoor
4. Mechanical Engineering: Khurmi & Gupta

### Project

On the basis of learning and skill acquired in the academic year, a project to be taken up by the student strengthening his/ her vocational skills

## Basic Electricity & Electronics - Lab

### Bridge course:

Introduction to current, voltage, resistance, capacitance, impedance, diode, zener diode, transistors, amplifiers, electric cells

1. Study of series resistive circuits.
2. Study of parallel resistive circuits.
3. Study of series and parallel connection of cells in circuits.
4. Preparation of Electrolyte for lead acid battery and its charging and measurement of Specific gravity with the help of hydrometer.
5. Charging and Discharging of a capacitor.
6. Verification of magnetic field of solenoid with Iron core and Air core.
7. Verification of Torque development in a current carrying coil in magnetic field.
8. Study of R.L.C. series circuit and measurement of power and power factor.
9. Study of current and voltage measurement using Ammeter and Voltmeter.
10. Study of current and voltage measurement using Galvanometer.
11. Study of current, voltage and resistance measurement using of Multi-meter
12. Study of Power and Energy measurement using Wattmeter and Energy meter.
13. Study of working of single layer PCB manufacturing.
14. Study of working of double layer PCB manufacturing.
15. Study and interpreting circuit diagram and to check the continuity of connections.

### Instrument Required:

1. Trainer kit for measuring TCR
2. Lead acid battery
3. Hydrometer
4. Trainer kit for measuring power and power factor in RLC circuits
5. Ammeter
6. Voltmeter
7. Multi-meter
8. Galvanometer
9. Energy Meter
10. PCB Manufacturing Facility



## Mechanical Workshop Practice

1. SHEET METAL WORKING AND SOLDERING:
  - a. (EX-1) Cutting, shearing and bending of sheet.
  - b. (EX-2) To prepare a soap case by the metal sheet
  - c. (EX-3) To make a funnel with thin sheet and to solder the seam of the same
  - d. (EX-4) To make a cylinder and to solder the same
  
2. FITTING SHOP WORK:
  - a. (EX-1) Hack sawing and chipping of M.S. flat
  - b. (EX-2) Filing and squaring of chipped M.S. job
  - c. (EX-3) Filing on square of rectangular M.S. Plate
  - d. (EX-4) Drill a hole in MS Block & tapping the same
  - e. (EX-5) Making a Bolt & Nut by Tap & Die set.
  
3. SMITHY SHOP WORK:
  - a. (EX-1) To prepare square angular piece by M.S. rod
  - b. (EX-2) To make square or hexagonal head bolt
  - c. (EX-3) To make a screw driver with metallic handle
  - d. (EX-4) To make ring with hook
  
4. Tin Smithy, Soldering, Brazing
  - a. (EX-1) To prepare different types of joint such as lap joint single seam, double seam & cap joint-hem & wired edge.
  - b. (EX-2) Utility article-waste paper basket or paper tray
  - c. (EX-3) Study & sketch stakes / anvils.
  
5. WELDING SHOP WORK:
  - a. (EX-1) Welding practice gas & electric arc welding
  - b. (EX-2) Welding for lap joint after preparing the edge
  - c. (EX-3) Welding Butt joint after preparing the edge
  - d. (EX-4) Gas Cutting
  - e. (EX-5) `T' joint welding after preparation of edge.

### Reference Books:

1. Workshop Technology, Vol. I: Hazra& Chaudhry
2. Elements of Workshop Technology Vol. I: BS Raghuwanshi

**Level 6 (SEMESTER- III)**  
**Metal Casting Technology**

**Unit 1**

**Introduction**

Design advantages of casting, Advantages of casting process, Metallurgical advantage. Technology of pattern making requirement, Pattern material, wood & wood product, plaster, Plastics and rubbers, Polyesters resins waxes, Machines and tools for pattern making machine for wood pattern making, Machines for metal pattern making, Allowance and other Technological considerations – contraction allowance, Machining allowance, Draft or taper allowance, Rapping and shake allowance, Distortion allowance, Core Prints, Core boxes, Use of loose pieces

**Unit 2**

**Technology of moulding and core making**

Moulding sands, Principal ingredients of moulding sands, Specification and testing of moulding sands, Classification of Moulding sands, Additives to moulding and Core making sands, Mould Dressings. Sand Conditioning, Sand Preparation equipment.

**Unit 3**

**Moulding processes**

Types of sand moulding, Tools for hand moulding, Characteristics of cores and core sands, Types of cores, Use of chaplets, Machine moulding, Core making machines, Processes based on organic binders.

**Unit 4**

**Technology of metal casting processes**

Permanent mould casting, Types of die casting machines, Centrifugal casting, continuous casting, Electro slag casting, Gating system, Riser of casting, Economic considerations, Melting equipments for foundries, Defects in castings.

**Unit 5**

**Modernization & Mechanization of foundries**

Need, Area for mechanization, Material handling, Pollution control in foundries, Pollutants in a foundry, Plant layout for foundries, steps in planning a foundry layout.

**Reference Books:**

1. Evolution of Metal Casting Technologies, Khan, Muhammad Azhar Ali, Sheikh, Anwar Khalil, Al-Shaer, Bilal Suleiman
2. Foundry technology, Peter R. Beeley

## Production Automation & Computer Integrating Manufacturing

### UNIT 1

**General:**Automation-Definition, Scope, its types and their merits, reasons for automation, Its appreciation and criticism, Meaning of the term Computer Integrated Manufacturing (CIM CAD/CAM) Relationship between CIM and Automation **FUNDAMENTALS OF MANUFACTURING AND AUTOMATION:** Types of Industries- Manufacturing, Processing; Basic producers, Converter, Fabricators. Types of Production-Job shop production, Batch production Mass production (Quantity Production and Flow production). Manufacturing - Functions - Processing - Basic processing, Secondary processing; Operations enhancing physical properties and finishing operations, Assembly, Material handling and Storage; Inspection and test and control, their meaning with automation point of view, Automation of welding Manufacturing Process Inputs - Raw materials, Equipments (Machine Tools), Tooling and fixtures, Energy and Labour, Outputs - Finished product and Scrape/Waste. Plant Layout - Its meaning and concept of fixed position layout, Process Layout, Product layout and Group technology layout, Organisation and Information Processing Business functions, Product design, Manufacturing planning and Manufacturing control

### UNIT 2

#### **Production Concept:**

Such as Manufacturing Lead Time (MLT), Production rate, Components of Operation Time, Production Capacity (PC), Utilisation and availability, Work in Process (WIP), Time in Plant (Tip), WIP Ratio, Tip ratio, their meaning and significance. Simple numerical problems Automation Strategies and Their Effect - Specification of operation, Combined operations, Simultaneous operations, Integration operations, Increase flexibility, Improved material handling and storage, on-line inspection, process control and optimization, Plant operation control, computer integrated manufacturing. **PRODUCTION ECONOMICS:** Methods evaluation investment alternatives, Constraints in manufacturing, Break Even Analysis, Unit Cost of Production, Cost of manufacturing, lead time and work in process.

### UNIT 3

#### **Assembly System and Line Balancing:**

The assembly process, Assembly system, Manual assembly lines, Line balancing problems, Computerised line, balancing methods, Other ways to improve the line balancing, flexible manual assembly line **AUTOMATED ASSEMBLY SYSTEMS:** Design for automated assembly, Types of automated assembly systems, Parts feeding devices, analysis of multi-station Assembly machines, Analysis of single station assembly machines

### UNIT 4:

#### **Numerical Control Production System**

Numerical controlling, Coordinate system, and Machine motions, Types of N.C. systems, Machine tool applications, Economics of NCS

### UNIT 5

**N.C. Part Programming:**Tape and Tape format, Methods of N.C. part programming, Computer assisted part programming, The APT Language, Manual data inputs, N.C. part programming using CAD/CAM and Computer automated part programming. **DNC, CNC & ADAPTIVE CONTROL:** Direct Numerical Control (DNC), Computer Numerical control (CNC), Adaptive Control Machining, Current trends in N.C., introductory idea of FMS (Flexible Manufacturing System)

#### **Reference Books:**

1. Numerical Control Machines: NK Mehta
2. Production Automation & Computer Integrated Manufacturing: MP Groover

## Fundamentals of Mechatronics

### Unit 1.

**Introduction:** Introduction to Mechatronics, systems, measurement systems, control systems, the Mechatronics approach. Introduction to Transducers: Sensors and transducers, operating characteristics of transducers, measurement of displacement, velocity, pressure, flow, and temperature.

### Unit 2.

**Signal conditioning:** Signal conditioning- their features and various blocks, the operational amplifiers, Protection, Filtering, Wheatstone bridge, Digital signals, Multiplexers, Data acquisition, Digital signal processing. Data Presentation Systems: Displays, Data presentation elements, Magnetic recording, Displays, Data acquisition system, Telemetry- electrical, optical and pneumatic methods of telemetry.

### Unit 3.

**Introduction to process control systems:** Importance of process control, analog and digital processing, Supervisory digital control, direct digital control. Controller Characteristics: Process characteristics, control system parameters, Discontinuous controller modes (two position, multiple position, floating position), Continuous controller modes i.e. P, I, D, PI, PD, PID.

### Unit 4.

**Introduction of Mechanical Actuation Systems:** Mechanical Actuation Systems for motion, Kinematics chains, Cams, Gear trains, Belt and chain drives, Bearings. Pneumatic and Hydraulic Systems: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure control valves, Cylinders, Process control valves, rotary actuators.

### Unit 5.

**Introduction of Electrical Actuation Systems:** Electrical systems, Mechanical Switches, Solid-state switches, Solenoids, DC motors, AC motors, Stepper motors.

#### Reference Books:

1. Mechatronic Systems: Fundamentals, R. Isermann
2. Fundamentals Of Mechatronics, M. Jouaneh

## Machining and Machine Tools

### Unit 1

#### Classification of Metal Removal Process and Machines Mechanics of Metal Cutting:

Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS, NRS and interrelationship, introduction of mechanism of chip formation and types of chips, chip breakers, orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting, thermal aspects of machining and measurement of chip tool interface, temperature, friction in metal cutting.

### Unit 2

#### Machinability:

Concept and evaluation of machinability, tool life, mechanisms of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability, Cutting fluids, types, properties, selection and application methods, General Purpose Machine Tools: tooling, attachments and operations performed, selection of cutting parameters, Simple calculation of time for machining.

### Unit 3

#### Special Purpose Machine Tools:

Automatic lathes, capstan and turret lathe machines, tracer attachment in machine tools, mechanical-copying machines, Hydraulic tracing Devices, Electric tracing systems, Automatic tracing, Abrasive Processes: Abrasives, natural and synthetic, manufacturing, nomenclature, selection of grinding wheels, wheel mounting and dressing, characteristic terms used in grinding, machines for surface and cylindrical grinding, their constructional details and processes, surface finishing, honing, lapping, super finishing, polishing and buffing processes.

### Unit 4

#### Thread and Gear Manufacturing:

Casting, thread chasing, thread cutting on lathe, thread rolling, die threading and tapping, thread milling, thread grinding, Gear Manufacturing Processes: Hot rolling, stamping, powder metallurgy, extruding etc. gear generating processes, gear hobbling, gear shaping, gear finishing processes, shaving, grinding, lapping, shot blasting, phosphate coating, gear testing.

### Unit 5

#### High Velocity Forming Methods:

(High-energy rate forming processes) Definition, Hydraulic forming, explosive forming, electro-hydraulic forming, magnetic pulse forming

#### Reference Books:

1. Machine Design, Sadhu Singh, Khanna Publishing House
2. Machine Design Data Book, Sadhu Singh, Khanna Publishing House

## Metal Casting Technology Workshop

Minimum work in each section is indicated against that PATTERN MAKING: (a) Making Patterns (At least two) (i) Solid one-piece pattern (ii) Split two piece pattern (iii) Split three-piece pattern (iv) Gated pattern (b) Making Core Boxes (At least one) (i) Straight Core Box (ii) Bent Core Box.

MOULDING SAND PREPARATION AND TESTING: (a) Sand Testing (At least one Experiments) (i) Grading (Grain Size). (ii) Determination of Moisture content (iii) Determination of Clay content. (iv) Determination of Permeability for gases (b) Preparation of: (i) Green Sand Composition. (ii) Dry sand Composition. (iii) Loam Sand composition (iv) Oil Sand for Cores.

MOULDING: (a) Making at least 3 sand moulds of different forms with different types of pattern using. (i) Floor Moulding. (ii) Two Box Moulding. (iii) Three Box (or more) Moulding. (b) At least one of the following: (i) Making and setting of cores of different types. (ii) Making one shell mould apparatus

(C) MELTING AND POURING: (Each to be demonstrated at least once in the section). (a) Demonstration of Melting of cast iron in (i) Pit Furnace. (ii) Cupola. (b) Demonstration of Melting a non-Ferrous metal in (i) Pit furnace. (ii) Tilting Furnace. (c) Pouring of metals in moulds (Ferrous and Non-Ferrous).

(D) CLEANING AND INSPECTION: (a) Shaking, cleaning and fettling of casting (At least 2 Casting) (b) (i) Inspection of cast component (visual) and preparing inspection report (At least one report). (ii) Establishing cause of Defects seen (At least one cause).

(E) CASE STUDY OF: At least 2 sand castings produced from sand preparation pattern layout to final finished casting.

## Mechatronics Lab

1. Displacement Measurement using Capacitive & inductive Pick –ups.
2. Study of Speed Measurement System: (a) Magnetic Pick-up (b) Stroboscope
3. Study of Load Measurement System Load Cell
4. Measurement of temperature using thermocouple, thermistor and RTD
5. Measurement of displacement using POT, LVDT & Capacitive transducer
6. Torque measurement using torque measuring devices
7. Strain Measurement using strain gauge
8. Frequency to Voltage Converter and vice versa
9. Position and velocity measurement using encoders
10. Study on the application of data acquisition system for industrial purposes

**Level 6 (Semester IV)**  
**Mass Production Devices**

**Unit 1**

Tool holders: Tool holders for turning and milling carbide inserts-types, ISO-designation and applications, Tool holding and tool mounting systems for conventional milling and drilling machine tools.

**Unit 2**

Locating and clamping devices: Concept, meaning and definitions of location and clamping, Use of locating and clamping principles in day-to-day supervision on shop floor, Degree of freedom-concept and importance, 3-2-1 principle of location, Locators-Types, Sketches with nomenclature, Working, Applications, Fool proofing and ejecting

**Unit 3**

Clamping devices: Types, Sketches with nomenclature, Working, Applications

**Unit 4**

Jigs and fixtures: Concept, meaning, differences and benefits of jigs and fixtures, Types, sketches with nomenclature, working and applications of jigs, Types, sketches with nomenclature, working and applications of fixtures

**Unit 5**

Design of Jigs and Fixtures: Steps in designing jigs and fixture for given simple component

**Reference Books :**

1. Mass Production ,phaidon

## Lean and Agile Manufacturing

### Unit 1

#### Introduction-

Introduction to Just in time production, Toyota production system, Introduction to lean manufacturing (LM), history of LM, advantages of LM over mass production

### Unit 2

#### Waste Identification-

Types of wastes, lean manufacturing principles; Value, value stream, flow, pull and perfection

### Unit 3

#### Value stream mapping-

Introduction to value stream mapping, types of value stream mapping, value added activities, necessary non value added activities, non-value added activities

### Unit 4

#### Lean manufacturing tools-

Introduction to 5S, Kanban, kaizen, work standardization, Statistical process control, automation and other lean tools

### Unit 5

#### Agile manufacturing-

Introduction to agile manufacturing, advantages of agile manufacturing, differences with lean manufacturing.

#### Reference Books:

1. Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities, Devadasan S.R
2. Learning Agile: Understanding Scrum, XP, Lean, and Kanban, Andrew Stellman, Jennifer Greene



## **Metal Forming Processes**

### **Unit 1**

#### **Rolling**

Introduction, Types of rolling, Hot rolling, Two high reversing mill, Three high mill, Continuous mill, Roll bending

### **Unit 2**

#### **Forging**

Introduction, Advantages of Forging, Application of Forging, Limitations of Forging, Upsetting, Hollow Forging, Impression die or closed, Methods of Forging, Drop Forging, Press Forging, Hammer and press Forging, Hot bar Forging, Upset Forging

### **Unit 3**

#### **Extrusion**

Direct and forward, Sleeve method of direct, Indirect or backward, Impact Extrusion, Tube Extrusion, Stepped Extrusion, Combined forging and Extrusion

### **Unit 4**

#### **Drawing**

Wire Drawing, Cupping and Bending, Tube Drawing, Spinning, Hot and cold Spinning Advantages of Metal Spinning

### **Unit 5**

#### **Pipe and Tube Production-**

Manufacturing of seamless pipe- Butt welded pipe- Lap welded pipe

#### **Reference Books:**

1. Sheet Metal Forming Processes: Constitutive Modelling and Numerical Simulation, D. Banabic
2. Metal Forming Processes, G. R. Nagpal

## Non-conventional Machining

### Unit-I

#### Introduction:

Limitations of conventional manufacturing processes need of unconventional manufacturing processes and its classification.

### Unit-II

#### Un-Conventional Machining Processes:

Principle and working and applications of unconventional machining processes such as Electric Discharge machining (EDM), Electro- Chemical machining (ECM), Ultrasonic Machining (USM), and Abrasive Jet machining (AJM)

### Unit-III

#### Un-Conventional Welding Processes:

Principle and working and applications of unconventional welding processes such as Laser Beam Welding, Electron Beam Welding, Ultrasonic Welding, Plasma Arc Welding processes.

### Unit-IV

#### Explosive Welding:

Cladding etc. Under water welding, Metalizing Theory, Process and applications

### Unit-V

#### Un-conventional forming processes:

Principle and working and applications of high energy forming processes such as Explosive forming, Electromagnetic forming. Electro discharge forming Water hammer forming, Explosive Compaction

#### Reference Books:

1. Modern Machining Process, P.C. Pandey
2. Un-conventional machining, V.K. Jain

## Tool & Die Making Lab

- Manufacture of Box Jig and Angle plate jig
- Manufacture of DzVdz Block angle grinding Fixtures and profile milling fixture
- Manufacture of simple Blanking & piercing Tool
- Manufacture of Progressive tool for producing a Cycle chain link
- Manufacture of Press tools like Combination tool & Compound tool
- Manufacture of Draw tool
- Trial out On Fly press and power press the Produced components such as V, U, Cycle link, Cup Washer and Cycle bell cup
- Manufacture of simple V and U bending tool
- Maintenance of Jig & fixture and press tool

## IT Tools Lab.

1. Spreadsheets, Word, Presentation
2. Multimedia Design
3. Troubleshooting
4. Project / Practical File
5. Viva Voce

## Level 7 (Semester V) Reliability, Maintenance and Safety Engineering

### Unit 1

#### Reliability

Definition, reliability function, Mean failure rate, mean time to failure (MTTF), mean time between failures (MTBF), hazard rate curve. Bathtub curve, Conditional Reliability

### Unit 2

#### Constant Failure rate model

Exponential Reliability function, Failure Modes, CFR model, memory lessness, System reliability: Series, parallel, mixed & complex configuration; Reliability improvement.

### Unit 3

#### Design for reliability

Reliability specifications and system measurements, System Effectiveness, redundancy, Classification of Redundancy, Introduction of failure mode and effect analysis (FMEA)

### Unit 4

#### Maintainability

Analysis of Downtime, repair time distribution, stochastic point processes.

### Unit 5

#### Safety engineering

Fundamentals of industrial safety, Safety policy and safety terminology, Different types of safety systems and equipments, Safety targets, standards, objectives

#### Reference Books:

1. Reliability Engineering, S.C. Sharma, Khanna Publishing House
2. Reliability, Maintenance and Safety Engineering, A.K. Gupta

## Plant Layout & Product Handling

Objective of Facility Design: Types of layout problems, the layout function, organization of layout. Analysis and Design of Material Flow: Systems approach to flow cycle, process charts, flow process charts, Quantitative analysis of material flow; optimal material flow configuration. Space and Area Allocation for Production and Physical Plant Services;

Computerized handling of layout algorithms; Algorithms for computerized Layout Planning, Construction and Development type of computerized Layout Planning Techniques i.e. CRAFT, ALDEP, CORELAP etc.;

Product handling; Design of system configurations conforming to various kinds of product features and layout characteristics; Design concepts of common handling and transfer equipment; Different types of conveyors, elevators, fork lifters;

Design concept of warehouse facilities commensurate with adopted kind of handling and transfer devices; Automated Handling of materials, Automated Transfer lines, AGVS, Use of Robots in Product handling, automated packaging devices.

Application of pneumatic and hydraulic system in transportation and handling of products, Design of integrated plant layout for product handling systems

### Reference Books:

1. Plant Layout and Materials Handling, S. C. Sharma
2. Plant Layout and Materials Handling ,R. B. Choudhary and G. R. N. Tagore

## Product Design for Manufacturing

### Unit 1

#### Importance of New Product

Importance of new product for growth of enterprise, Definition of product and new product, Classification of products from new product development point of view- Need based/Market pull products, Tech. push, Platform based, Process based and customized products

### Unit 2

#### New product development process and organization

Generic product development process for Market Pull and Market Push Products, Need Identification and Analysis, Problem Formulation, establishing economic existence of need, Engineering Statement of Problem, Establishing Target Specification

### Unit 3

#### Generation of Alternatives and Concept Selection

Introduction to Concept generation, Tools of creativity like brain storming, Analogy, Inversion, introduction to Concept feasibility and Concept Selection, Establishing Engineering Specification of Products

### Unit 4

#### Preliminary and Detailed Design

Preliminary design, Identification of subsystems, Subsystem specifications, detailed design of subsystems, component design

### Unit 5

#### Assembly drawing and review

Preparation of assembly drawings, Review of product design from point of view of Manufacturing, Ergonomics and aesthetics

#### Reference Books:

1. Manufacturing Processes for Design Professionals, Rob Thompson
2. Product design for manufacture and assembly, Geoffrey Boothroyd

## CAD & CAM

### Unit 1

#### Introduction CIM and CAD & Analysis:

CIM: Introduction of CIM– concept of CIM - evolution of CIM – CIM wheel –Benefits – integrated CAD/CAM. CAD: Introduction– CAD definition – Shigley’s design process – CAD activities – benefits of CAD. Types of CAD systems, CAD software packages, 2D & 3D transformations, Geometric modeling: Techniques: Wire frame modeling – surface modeling – solid modeling

### Unit 2

#### Computer aided Manufacturing CAM:

Definition, functions, benefits. Group technology – Part families - Parts classification and coding - coding structure – Optiz system, MICLASS system and CODE System - process planning – CAPP – Types of CAPP: Variant type, Generative type – advantages of CAPP – production planning and control – computer integrated production management system – Master Production Schedule (MPS) – Capacity planning – Materials Requirement Planning (MRP) –Manufacturing Resources Planning (MRP-II)

### Unit 3

#### CNC Machine and Components:

CNC Machines: Numerical control – definition – components of NC systems – development of NC – DNC – Adaptive control systems – working principle of a CNC system – Features of CNC machines - advantage of CNC machines – difference between NC and CNC – Construction and working principle of turning centre – Construction and working principle of machining centers – machine axes conventions turning centre and machining centre – design considerations of NC machine tools.

### Unit 4

#### Part Programming

NC part programming – methods – manual programming – conversational programming – APT programming - Format: sequential and word address formats - sequence number – coordinate system – types of motion control: point-to-point, paraxial and contouring – Datum points: machine zero, work zero, tool zero NC dimensioning – reference points – tool material – tool inserts - tool offsets and compensation - NC dimensioning – preparatory functions and G codes, miscellaneous functions and M codes – interpolation: linear interpolation and circular interpolation.

### Unit 5

#### FMS, Integrated Material Handling and Robot:

Types of manufacturing - introduction to FMS – FMS components – FMS layouts – Types of FMS: flexible manufacturing cell – flexible turning cell – flexible transfer line – flexible machining systems – benefits of FMS - introduction to intelligent manufacturing system – virtual machining. Computer Integrated material handling – AGV: working principle – types, benefits – Automatic Storage and Retrieval Systems (ASRS). ROBOT – definition – robot configurations – basic robot motion – robot programming method – robotic sensors - industrial applications: characteristics, material transfer, machine loading, welding, spray coating, assembly and inspection.

#### Reference Books:

1. Engineering AutoCAD, Pradeep Jain & A.P. Gautam, Khanna Publishing House
2. Engineering Graphics and Design, Pradeep Jain & A.P. Gautam, Khanna Publishing House

### **CAD Lab**

1. Introduction and different features of the CAD Software.
2. 2-D Drafting.
3. 3-D Modeling.
4. 3-D Advanced Modeling.
5. Assembly modeling.
6. Feature Modification and Manipulation
7. Detailing.
8. Sheet Metal Operations.
9. Surface Modeling.

### **CAM Lab**

1. To prepare part programming for plain turning operation.
2. To prepare part programming for turning operation in absolute mode.
3. To prepare part program in inch mode for plain turning operation.
4. To prepare part program for taper turning operation.
5. To prepare part program for turning operations using turning cycle.
6. To prepare part program for threading operation.
7. To prepare part program for slot milling operation.
8. To prepare part program for gear cutting operation.
9. To prepare part program for gear cutting using mill cycle.
10. To prepare part program for drilling operation

**Level 7 (Semester VI)**  
**Rapid Prototyping and Reverse Engineering**

**Unit 1**

**Introduction**

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

**Unit 2**

**CAD Modelling and Data Processing for RP**

CAD model preparation, Data Requirements, different types of Data formats, Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

**Unit 3**

**RP Systems**

Photo-polymerization process, Powder Bed Fusion process, Applications of Powder Bed Fusion Processes. Extrusion - Based RP Systems, 3D Printing process modelling, Applications of Printing Processes. Sheet Lamination process /Laminated Object Manufacturing (LOM), Beam Deposition: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing - structure-properties, relationships, Benefits and drawbacks.

**Unit 4**

**Rapid Tooling:**

Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

**Unit 5**

**RP Applications:**

Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP

**Reference Books:**

1. Rapid Product Development (English, Paperback, Kimura Fumihiko)



## **Production Planning and Control**

### **Unit 1**

#### **Demand Forecasting**

Introduction, components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Selection of forecasting technique.

### **Unit 2**

#### **Capacity Planning**

Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost-Volume analysis.

### **Unit 3**

#### **Facility Location**

Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, fixed position, combination and cellular layouts; Designing product and process layout, line balancing.

### **Unit 4**

#### **Production Control**

Capacity control and priority control, production control functions; Routing, scheduling, Dispatching, expediting and follow up, Techniques of production control in job shop production, batch production and mass production systems

### **Unit 5**

#### **Sequencing**

Priority rules, sequencing methods, sequencing jobs through two work centers, scheduling services, application of CPM and PERT techniques.

#### **Reference Books:**

1. Production Planning and Control, W. Bolton
2. Production Planning and Control with SAP, Jörg Thomas Dickersbach and K. Wehrauch

#### **Project**

On the basis of learning in the B.Voc. Programme, i.e. Level 5 to Level 7, a project to be taken up by the student strengthening his/ her vocational skills.

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc  
Industrial Tool Manufacturing (IM)  
Branch Code:104  
Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

**Evaluation Scheme**  
**B. Voc Industrial Tool Manufacturing**

<b>NSFQ Level 5 SEMESTER- I</b>											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BIMV511	Machine Tool Technology		10	5	5	20	30		50	2
2	BIMV512	General Mechanical Engineering – I	30	10	5	5	20	30		50	2
3	BIMV513	Manufacturing Technology -I	30	10	5	5	20	30		50	2
4	BIMV514	Metrology and Measuring Instruments	30	10	5	5	20	30		50	2
5	BIMP511	Metrology and Measuring Instruments Lab	30				20		30	50	1
6	BIMP512	Machine Tool Technology Lab	30				20		30	50	1
7	BIMP513	Language Lab	30				20		30	50	2
8	BIMT511	Metal Arc Welding (CSC/Q0204)						Any one Training 400 hrs/ 8 weeks		150	12
	BIMT512	MIG MAG or GMAW Welder (CSC/Q0209)									
	BIMT513	Assistant TIG Welder (CSC/Q0212)									
	BIMT514	CNC Setter Cum Operator (CSC/Q0120)									
	BIMT515	CNC Operator – VMC (CSC/Q0116)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>
<b>NSFQ Level 5 SEMESTER- II</b>											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BIMV521	Total Quality Management	30	10	5	5	20	30		50	2
2	BIMV522	General Mechanical Engineering – II	30	10	5	5	20	30		50	2
3	BIMV523	Manufacturing Technology -II	30	10	5	5	20	30		50	2
4	BIMV524	Industrial Engineering	30	10	5	5	20	30		50	2
5	BIMP521	Project	30				20		30	50	1
6	BIMP522	Engineering Graphics	30				20		30	50	1
7	BIMP523	Mechanical Workshop Practice	30				20		30	50	2
8	BIMT521	Metal Arc Welding (CSC/Q0204)						Any one Training (other than 1 <sup>st</sup> sem) 400 hrs/ 8 weeks		150	12
	BIMT522	MIG MAG or GMAW Welder (CSC/Q0209)									
	BIMT523	Assistant TIG Welder (CSC/Q0212)									
	BIMT524	CNC Setter Cum Operator (CSC/Q0120)									
	BIMT525	CNC Operator – VMC (CSC/Q0116)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

NSFQ Level 6 SEMESTER- III												
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit	
				CT	TA	AT	Total	TE	PE			
1	BIMV631	Tool Engineering – I	30	10	5	5	20	30		50	2	
2	BIMV632	Production Automation & Computer Integrated Mfg	30	10	5	5	20	30		50	2	
3	BIMV633	Fundamentals of Mechatronics	30	10	5	5	20	30		50	2	
4	BIMV634	Machining and Machine Tools	30	10	5	5	20	30		50	2	
5	BKVH631	Human Values and Professional Ethics	30	10	5	5	20	30		50	2	
6	BIMP631	Tool Engineering Lab	30				20		30	50	1	
7	BIMP632	Mechatronics lab – Practical	30				20		30	50	1	
8	BIMT631	Service Engineer – Installation (CSC/Q0501)								Any one Training 400 hrs/ 8 weeks	150	12
	BIMT632	Quality Inspector-Forged, Casted or Machined Component (CSC/Q0601)										
	BIMT633	CNC Programmer (CSC/Q0401)										
	BIMT634	Maintenance Fitter – Mechanical (CSC/Q901)										
	BIMT635	CNC Setter Cum Operator – VMC (CSC/Q0123)										
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>	
NSFQ Level 6 SEMESTER- IV												
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit	
				CT	TA	AT	Total	TE	PE			
1	BIMV641	Tool Engineering – II	30	10	5	5	20	30		50	2	
2	BIMV642	Agile and Lean Manufacturing Systems	30	10	5	5	20	30		50	2	
3	BIMV643	Metal Forming Processes	30	10	5	5	20	30		50	2	
4	BIMV644	Mass Production Devices	30	10	5	5	20	30		50	2	
5	BKVE641	Environment and Ecology	30	10	5	5	20	30		50	2	
6	BIMP641	Tool and Die Making Lab - Practical	30				20		30	50	1	
7	BIMP642	IT Tool Lab	30				20		30	50	1	
8	BIMT641	Service Engineer – Installation (CSC/Q0501)								Any one Training (other than 3rd sem)400 hrs/ 8 weeks	150	12
	BIMT642	Quality Inspector-Forged, Casted or Machined Component (CSC/Q0601)										
	BIMT643	CNC Programmer (CSC/Q0401)										
	BIMT644	Maintenance Fitter – Mechanical (CSC/Q901)										
	BIMT645	CNC Setter Cum Operator – VMC (CSC/Q0123)										
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>	

GV: General Vocational; VP: Vocational Practical; OJT: On Job Training; SSC: Sector Skill Council

NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BIMV751	Reliability, Maintenance & Safety Engineering	30	10	5	5	20	30		50	2
2	BIMV752	Design Concepts in Engineering	30	10	5	5	20	30		50	2
3	BIMV753	Product Design and Development	30	10	5	5	20	30		50	2
4	BIMV754	CAD & CAM	30	10	5	5	20	30		50	2
5	BKVH751	Constitution of India, Law and Engineering	30	10	5	5	20	30		50	2
6	BIMP751	CAD Lab	30				20		30	50	1
7	BIMP752	CAM Lab	30				20		30	50	1
8	BIMT751	Tool & Die Maker (CSC/Q0306)					Any one Training 400 hrs/ 8 weeks		150	12	
	BIMT752	Designer – Mechanical (CSC/Q0405)									
	BIMT753	Service Engineer – Breakdown Service (CSC/Q0503)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BIMV761	Rapid Prototyping and Reverse Engineering	30	10	5	5	20	30		50	2
2	BIMV762	Process Planning and Cost Estimation	30	10	5	5	20	30		50	2
3	BKVH761	Indian Tradition, Culture and Society	30	10	5	5	20	30		50	2
4	BIMP761	Major Project	180						150	150	6
5	BIMT761	Tool & Die Maker (CSC/Q0306)					Any one Training (other than 5 <sup>th</sup> sem) 400 hrs/ 8 weeks		200	12	
	BIMT762	Designer – Mechanical (CSC/Q0405)									
	BIMT763	Service Engineer – Breakdown Service (CSC/Q0503)									
<b>Total</b>			<b>670</b>							<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

**Level 5 (Semester I)**  
**Machine Tool Technology**

**Unit 1: Centre Lathe**

The centre lathe and its principle of working, Types of lathes, Lathe specification and size, Features of lathe bed, Head stock and tail stock, Feed mechanism and change-gears. carriage saddle, Cross slide, Compound rest, Tool post, Apron mechanism, lathe accessories, Chucks, Face plate, Angle plate, Driving plate, Lathe dogs, mandrils, Steady rest, Lathe attachments, Lathe operations-plane and step turning, Taper turning, Screw cutting, Drilling, Boring, reaming, Knurling, Parting off, Under cutting, Relieving, Types of lathe tools and their uses, Brief description of semi-automatic lathes such as capstan and turret lathes, their advantages and disadvantages over centre lathe, types of job done on them. General and periodic maintenance of a centre lathe.

**Unit 2: Shaping, Planing & Slotting Machines**

Working principles of planer, shaper and Slotter, Differences and similarities among them, quick return mechanism applied to the machines. Types of work done on them, types of tools used, their geometry, General and periodic maintenance of a shaper.

DRILLING & BORING MACHINES: Types of tools used in drilling and boring. Classification of drilling and boring machines, principle of working and constructional details of simple and radial drilling M/C and general and periodic maintenance. Operations like facing, counter boring, tapering.

**Unit 3: Milling Machines**

Types of milling machines, constructional features of horizontal milling M/C. general maintenance of the machine, types of milling cutters, milling operations like plane milling, space milling, angular milling form milling, straddle milling, gang milling, Negative rake milling, cutting speed and speed for different tools in up and down milling. Simple, compound and differential indexing, milling of spur gears and racks

**Unit 4: Grinding Machines**

Common abrasives, grinding wheel materials, Bonds, Grain and grit of abrasive, Grain structure and shapes of common wheels, various speeds and feeds, Use of coolants, Methods of grinding, Types of grinding machines, precision finishing operations like honing.

BROACHING MACHINES: Types of work done on broaching machine. Simple types of broaches and their uses, Types of broaching machines

**Unit 5: Jigs and Fixtures**

Object of Jigs and Fixture, Difference between jigs and fixtures, Principle of location, Principle of clamping, Locating and clamping devices. Types of jigs -Simple open and closed (or box) jigs. Drill jigs-bushes (Fixed, Liner, Renewal, and Slip). Template, Plate jigs. Channel jigs, Leaf jigs, Simple example of milling, turning, grinding, horizontal boring fixtures and broaching fixtures, Welding fixtures

COOLING PROCESS: Cooling and cutting fluids, difference between coolant and cutting fluid, function and action of cutting fluids, Requirement of good cutting fluids, their selection for different materials and operations  
AUTOMATION OF MACHINE TOOLS: Introduction to CNC lathe (Computer Numerical Control Lathe) and FMS (Flexible Manufacturing System) Introduction only.

**Reference Books:**

1. Production Technology: Jain & Gupta
2. Workshop Technology Vol. II: Hazra & Choudhary

## **General Mechanical Engineering - I Unit 1:**

### **Strength of Materials & Power Transmission**

Stress, strain, elastic constraints, stress in circular shaft subjected to pure torsion only, Riveted and bolted joints.

### **Unit 2: Shear Force & Bending Moment**

Elementary idea of Shear force and bending moment for concentrated, uniformly distributed loads on simply supported beam cantilever and overhanging beam, Simple Shear force and bending moment diagrams, Relationship between shear force and bending moment

### **Unit 3: Power Transmission: Pulleys, Gears & Shaft**

Classification of Pulleys, Types of Belts, Simple calculation of pulley diameter, Classification of Gears, Simple calculation of number of teeth and speed, Power transmission by solid and hollow shaft

### **Unit 4: Hydraulics & Hydraulic Machines**

Properties of fluids, pressure of fluid and its measurement. Flow of fluids, velocity and discharge, Bernoulli's theorem and its application in venturimeter, flow through pipe, head loss due to friction

### **Unit 5: Water Turbines & Pumps**

Capacity & Working of Turbines- Pelton and Reaction, reciprocating and centrifugal pump

### **Reference Books:**

1. Basic Mechanical Engineering, M.P. Poonia & S.C. Sharma, Khanna Publishing House
2. Strength of Materials, D.S. Bedi, Khanna Publishing House

## Manufacturing Technology –I

### Unit 1

(A) General Introduction: (a) Scope of subject "Workshop Technology" in engineering (b) different shop activities and broad division of the shops on the basis of nature of work done such as (i) Wooden Fabrication-carpentry (ii) Metal Fabrication (shaping and Forming, Smithy, sheet metal and Joining-welding, Riveting, Fitting and Plumbing).

(B) Carpentry: (a) Fundamental of wood working operations (b) Common Carpentry Tools- Their classification, size, specification (name of the parts and use only): (i) Marking and measuring tools (ii) Holding and supporting tools: (iii) Cutting and Sawing Tools: (iv) Drilling and Boring Tools (v) Striking Tools-Mallet and Claw hammer (vi) Turning Tools & Equipment (vii) Miscellaneous Tools

### Unit 2

(A) Joining of Timber Components for Fabrications Works: Assembly of joints (Preparation steps and tools used only) Mortise, Tenon, Rivet, Groove, Tongue, Dowel, operations in assembly-simple lap and butt, Mortise, Tenon, Dovetail, Miter & bridle joints.

Metal Fabrication

(B) Metal Shaping-Smithy: (i) Operations involved (concept only) (ii) Tool and equipment used (Names, size, specification for identification only) (iii) Heating and fuel handling equipment (iv) Holding and supporting tools (v) Striking Tools (vi) Cutting tools (vii) Punching & Drifting Tools (viii) Bending Tools and figures (ix) Forming & Finishing Tools (x) Defects Occurring & its remedy

### Unit 3

Sheet metal Working-Tools and operation: (1) Operations involved (Names and concept only) (2) Sheet metal joints (3) Tools and equipment used (Name, size, specifications for identification only) (4) Marking tools (5) Cutting and shearing Tools (6) Straightening tool (7) Striking Tools (8) Holding Tools (9) Supporting Tools (10) Bending tools (11) Punching-Piercing and Drafting tools (12) Burring Tools-Files (13) Defects Occurring & its remedy

### Unit 4

(A) Metal Joining During Fabrication-

(a) Permanent Joining: (i) Welding methods (ii) Electric welding

(b) Soldering & Brazing: (i) Its concept, comparison with welding as joining method and classification (ii) Soldering operation (iii) Materials Used (iv) Defects Occurring & its remedy

(B) Riveting- (i) Its comparison with welding as joining method. (ii) Rivets and Materials. (iii) Operation involved (iv) Tools and equipment used (Names, Size, specification and uses)), Elementary knowledge about working of pneumatic, hydraulic and electric riveter. Temporary Joining (Fasteners & their uses), General Idea about temporary fasteners & their uses

(C) Familiarity with the Use of Various Tools Used in Mechanical Engineering Workshop (a) Marking & Measuring Tools (b) Holding Tools (c) Cutting Tools (d) Files (e) Thread Cutting Tools (h) Miscellaneous Tools

They should be shown physically to each student for familiarity.



## Unit 5

(A) Protection of Fabricated Structures from Weather:

(a) Painting: Its need, Introduction to methods of painting (classification only) operations involved description steps only, surface preparation materials, tools and equipment used (name, size specification for identification), Brushes-round and flat wire brush, scraper, trowel, spray gun, compressor, defects likely to occur in painting and their remedies

(b) Varnishing & Polishing: Its need, operation involved (description of steps only), surface preparation method of old and new articles, application of polishing materials, materials used for preparation of french and sprit polish, copal varnish, defects likely to occur.

Safety of Personnel, Equipment & Tools to be observed

(B) Foundry Work:

Elementary idea of patterns, green sand moulds and moulding, tools and equipment used in green sand moulding

### Reference Books:

1. Workshop Technology, Vol. I: Hazra& Chaudhry
2. Workshop Technology, Vol. I: BS Raghuwanshi
3. KaryashalaTakniki: JK Kapoor

## Metrology and Measuring Instruments

### Unit 1

**Introduction:** Meaning and scope of metrology in field of engineering, Standards and types of measurements (Line and Wave, length, Primary, Secondary and Tertiary measurement concept only). Limits, Fits and Tolerances, Interchangeability, precision and accuracy, Sources of error

**PRINCIPLES AND CLASSIFICATIONS OF MEASURING INSTRUMENTS:**

- (i) Principle of Mechanical Measuring Instruments: Lever method, Vernier method, screw and screw nut method, compound gearing and helical spring methods.
- (ii) Principles of Optical Instruments: Reflection, Refraction, Interference, Polarisation, Optical prisms, Lenses and Optical projectors.
- (i) Principles of Electrical measuring Instruments.
- (ii) Principles of Hydraulic and Pneumatic Instruments.

### Unit 2:

#### Comparators

General principles of constructions, balancing and graduation of measuring instruments, characteristics comparators, use of comparators, difference between comparators, limit gauges and measuring instruments. Classification of comparators, construction and working of dial indicator, mechanical comparator, mechanical-optical, zeissoptotest, electro limit, electromechanical electronics, pneumatic comparators, gauges, tool makers microscope.

### Unit 3:

#### Surface Finish

Geometrical characteristics of surface roughness- Wavyness, layflaws, Effect of surface quality on its functional properties. Factor affecting the surface finish, Drafting symbols for surface roughness, Evaluation of surface finish RMS and CLS values, Methods of measuring surface roughness qualitative and quantitative methods, Comparison of surface produce by common production methods.

### Unit 4

#### Various Types Of Instruments Used For:

1. (a) Physical Measurements such as-Length, distance, height, Thickness, Gaps, Curvature, Angle, Taper, Area, Undulations, Surface finish, Thread and Gear measurement (b) Liquid Level & Viscosity- Liquid level measuring methods and devices, Viscometer - Plate and cone Viscometer, Two float viscometer, Rheo viscometer
2. Mechanical Quantities: (a) Displacement. velocity, acceleration, space torque-Use of transducers and electronic count stroboscope, vibrating reeds and technometers (b) Pressure and Vacuum - Idea of atmosphere pressure, Gauge pressure and vacuum - Use of instruments such as manometers and those use elastic elements such as diaphragm, capsule Bellows, Bourdon tube and various transducers thermo couple, vacuum gauges (c) Strain - Use of Strain gauge and load cells (d) Mechanical Power - Dynamometers - absorption and transmission type both. (Reference Only)

TEMPERATURE MEASUREMENT: Various types of thermometers, thermocouples, pyrometers (Radiation and optical type both)

#### **Unit 5**

##### **Inspection of Geometrical Errors:**

Construction and working of auto collimeter, checking of straightness, flatness, squareness and parallelism, circularity (By dial gauge and telerod).

MAINTENANCE OF MEASURING INSTRUMENTS: Defects likely to occur in measuring instruments and their remedies. General maintenance of measuring instruments

##### **Reference Books:**

1. Metrology: RK Jain
2. Mechanical Measurement: RK Jain

## Metrology and Measuring Instruments

### UNIT 1

**INTRODUCTION:** Meaning and scope of metrology in field of engineering, Standards and types of measurements (Line and Wave, length, Primary, Secondary and Tertiary measurement concept only). Limits, Fits and Tolerances, Interchangeability, precision and accuracy, Sources of error **PRINCIPLES AND CLASSIFICATIONS OF MEASURING INSTRUMENTS:** (a) Principle of Mechanical Measuring Instruments: Lever method, Vernier method, screw and screw nut method, compound gearing and helical spring methods. (b) Principles of Optical Instruments: Reflection, Refraction, Interference, Polarisation, Optical prisms, Lenses and Optical projectors. (c) Principles of Electrical measuring Instruments. (d) Principles of Hydraulic and Pneumatic Instruments.

### UNIT 2:

**COMPARATORS** General principles of constructions, balancing and graduation of measuring instruments, characteristics comparators, use of comparators, difference between comparators, limit gauges and measuring instruments. Classification of comparators, construction and working of dial indicator, mechanical comparator, mechanical-optical, zeissoptotest, electro limit, electromechanical electronics, pneumatic comparators, gauges, tool makers microscope.

### UNIT 3:

**SURFACE FINISH** Geometrical characteristics of surface roughness- Wavyness, layflaws, Effect of surface quality on its functional properties. Factor affecting the surface finish, Drafting symbols for surface roughness, Evaluation of surface finish RMS and CLS values, Methods of measuring surface roughness qualitative and quantitative methods, Comparison of surface produce by common production methods.

### UNIT 4:

**VARIOUS TYPES OF INSTRUMENTS USED FOR:** (i) (a) Physical Measurements such as-Length, distance, height, Thickness, Gaps, Curvature, Angle, Taper, Area, Undulations, Surface finish, Thread and Gear measurement (b) Liquid Level & Viscosity-Liquid level measuring methods and devices, Viscometer - Plate and cone Viscometer, Two float viscometer, Rheo viscometer (ii) Mechanical Quantities: (a) Displacement. velocity, acceleration, space troque-Use of transducers and electronic count stroboscope, vibrating reeds and technometers (b) Pressure and Vacuum - Idea of atmosphere pressure, Gauge pressure and vacuum - Use of instruments such as manometers and those use elastic elements such as diaphragm, capsule Bellows, Bourdon tube and various transducers thermo couple, vacuum gauges (c) Strain - Use of Strain gauge and load cells (d) Mechanical Power - Dynamometers - absorption and transmission type both. (Reference Only) **TEMPERATURE MEASUREMENT:** Various types of thermometers, thermocouples, pyrometers (Radiation and optical type both)

## **UNIT 5**

**INSPECTION OF GEOMETRICAL ERRORS:** Construction and working of autocollimeter, checking of straightness, flatness, squareness and parallelism, circularity (By dial gauge and telerod).

**MAINTENANCE OF MEASURING INSTRUMENTS:** Defects likely to occur in measuring instruments and their remedies. General maintenance of measuring instruments

### **Reference Books:**

1. Metrology: RK Jain
2. Mechanical Measurement: RK Jain

### **Metrology and Measuring Instruments lab.**

1. Measurement of angle with the help of sine bar/ Vernier Bevel protractor.
2. Study and sketch of various types of optical projectors.
3. Study and sketch of various types of comparators and use them for comparing length of given piece.
4. To measure the diameter of a hole with the help of precision balls.
5. To measure external and internal taper with the help of taper gauges, precision rollers.
6. To test the squareness of a component with auto-collimeter.
7. To measure the pitch, angle and form of thread of a screw.
8. To measure the geometry of a gear having involute profile.
9. To measure the straightness of the edge of a component with the help of auto-collimeter.
10. To measure the length, breadth, thickness, depth, height with micrometer.
11. To measure the length, breadth, thickness, depth, height, with height gauge and Vernier calipers.
12. Calibration of Vernier calipers/micrometers.
13. Calibration of height gauge/depth gauge.
14. Study of a tool maker's microscope.
15. Checking of accuracy of snap gauge with slop gauge.
16. Checking of accuracy of a plug gauge with micrometer.
17. Measurement of areas by polar planimeter.
18. Use of feeler, wire, radius and fillet gauges measurement of standard parameters.

### **Machine Tool Technology Lab.**

#### **(A) MACHINE SHOP**

1. (a) Square thread cutting (internal and external) - 2 jobs  
(b) Multi-start thread cutting - 1 job  
(c) Eccentric Turning - 1 job
2. Making utility job - Planner, Shaper, Slotter - 1 job
3. Group work on milling machine involving up & down milling in:  
(a) Gang milling - 1 job  
(b) Spur gear cutting - 1 job  
(c) Helical gear cutting - 1 j

#### **(B) FITTING SHOP**

1. To make a cut and cup tool - 1 job
2. To make blank and pierce tool - 1 job
3. To make a male and female fitting jobs - 1 job
4. To grind a lathe/shaper/planer tool - 1 job
5. To make different types of keys - 3 jobs
6. To make complete gauge - 2 jobs

## Level 5 (Semester II)

### Total Quality Management

#### 1. Introduction, Basic concepts of total quality management

Introduction to Quality, Dimensions of Quality, Quality Planning, Concept and definition of quality cost, Determinants of Quality, Optimum cost of performance, Principles of TQM, Pillars of TQM, Introduction to leadership and Leadership roles, Quality council and Quality statement, Strategic Planning Process, Deming philosophy

#### 2. Continuous process improvement

Input /output process Model, Juran trilogy, PDCA Cycle, 5–‘S’ Housekeeping principle, Kaizen Seven tools of Quality (Q-7 tools), Check Sheet, Histogram, Cause and effect diagram, Pereto diagram, Stratification analysis, Scatter diagram, Control charts, Control chart for variables & process capability, Control chart for attributes

#### 3. Management planning tools & Bench marking

Affinity diagram, Relationship diagram, Tree diagram, Matrix diagram, Matrix data analysis, Arrow Diagram, Process decision programme chart (PDPC), Concept of bench marking, Reason to bench marking, Bench marking process, Types of bench marking, Benefits of bench marking

#### 4. Just in time (JIT)

JIT philosophy, Three elements of JIT, Principles of JIT Manufacturing, JIT Manufacturing building blocks, JIT benefits, Kanban & 2 Bin Systems

#### 5. Total productive maintenance (TPM)

Concept of Total Productive Maintenance, Types of maintenance, OEE (Overall Equipment Efficiency), Stages in TPM implementation, Pillars of TPM, Difficulties faced in TPM implementation.

#### Reference Books:

1. Total Quality Management, S.C. Sharma, M.P. Poonia, Khanna Publishing House

## General Mechanical Engineering - II

### Unit 1:

#### Basics of Thermodynamics

Basic definition of heat, work, Thermodynamic process, parameters of working body and their units, Equation of state, Universal gas constant, Relation between heat capacity and temperature. Determination of quantity of heat

### Unit 2:

#### Laws of Thermodynamics

Elementary concept of laws of thermodynamics, first law and second law, Graphical representation of process, The work of expansion and compression of a gas, Change in the state of ideal gas-Isochoric, Isothermal and Adiabatic process, Carnot-cycle

### Unit 3:

#### IC Engines

External & internal combustion engines, working of diesel and petrol engine, horse power of IC engines

### Unit 4:

#### Steam Generators & Condensers

Construction and working of Babcock & Wilcox boiler, Cochran boiler, Steam condenser & its types

### Unit 5: Steam & Gas Turbines

Steam turbine, classification and principle of operation, gas turbine

#### Reference Books:

1. Basic Mechanical Engineering, M.P. Poonia & S.C. Sharma, Khanna Publishing House
2. Strength of Materials, D.S. Bedi, Khanna Publishing House
3. General Mechanical Engineering: Jk Kapoor
4. Mechanical Engineering: Khurmi & Gupta



## Manufacturing Technology – II

### UNIT I

**GENERAL PROCESS:** Classification and elementary idea of metal forming processes on the basis of the properties of deformability (Plasticity), fusibility and divisibility viz., Rolling, Forging, Drawing, Extruding, Spinning, Pressing, Punching, Blanking, Welding, Soldering, Brazing, Metal cutting processes-turning, Drilling, Boring, Shaping, Grinding, Elementary idea of machines used for the above processes.

**WELDING:** (a) Weld edge preparation, Introduction to various welding processes with procedure equipment and applications such as (i) Electric arc welding. (ii) Resistance welding. (iii) Thermit welding (iv) Carbon arc gauging. (v) Metal-Inert-Gas welding (MIG)

(vi) Tungsten Inert Gas welding (TIG) (vii) Atomic Hydrogen arc welding. (viii) Stud welding. (ix) Laser Beam, Electron Beam welding, Explosion welding (b) Welding Arcs: Definition, arc initiation, arc structures, types of arc, metal transfer characteristics and influencing parameters, weld bead geometry, various types of electrodes used in various processes.

### UNIT 2

**WELDING OF SPECIAL MATERIALS:** (a) Welding of plastics, equipment, filler rods, weldability, procedures and precautions. (b) Welding of Grey Cast Iron, shielded metal arc gas welding procedures. (c) Welding of Aluminium, Argon arc and gas welding procedures.

(d) Welding of copper, Brass and Bronze, Gas shielded metallic arc welding, TIG, Oxy-acetylene method.

**TESTING OF WELDS & RELEVANT WELDING CODES:** (a) Destructive methods (b) Non-destructive methods-visual, X-ray, Y-ray, Magnetic particles, fluorescent, penetrant and ultrasonic testing.

### UNIT 3 & UNIT 4:

**FOUNDRY PRACTICE PATTERN & MOULDING:** The pattern materials used, Types of pattern allowances and pattern layout, Colour scheme patterns defects, Types of cores and their utility.

**Moulding and Pouring:** Classification of mould materials according to characteristics, Types of sands and their importance test, parting powders and liquids, Sand mixing preparation, Moulding defects

**MELTING AND POURING:** Brief idea of refractory material and fluxes, Fuels and metallic materials used in foundry. Melting furnaces used in foundry such as pit furnace, Tilting and cupola furnaces, their construction and operation, metals and alloys. Additions to molten metal, Closing and pouring of the moulds, Coring-up, venting and closing, use of ladles, spur and risers, Defects due to closing and spurring, Basic idea of fettling operations. Surface treatment, salvaging of castings, Factors determining soundness of casting.

### UNIT 5

**FOUNDRY PRACTICE:** Elementary idea of special casting Processes-Shell mould casting, die casting, investment mould casting, centrifugal and continuous casting full mould casting. Elementary idea of mechanisation of foundries

**POWDER METALLURGY:** Introduction, principle, scope and names of processes. Production of metal powders, compaction, sintering and sizing, Self-lubricated bearings. Advantages of the process and its limitations (Elementary concept only)

#### Reference Books:

1. Workshop Technology, Vol. I: BS Raghuvanshi
2. Production Technology, Vol. I: Hazra & Chaudhry

## Industrial Engineering

### UNIT 1

**INSPECTION:** Inspection and its objective, Types of inspection, Inspection standards, Duties of inspection foreman **QUALITY CONTROL:** Concept of quality control, Elements of quality control, quality control groups, objectives of quality control. Statistical quality control, objectives of S.Q.C. Inspection by variables & attributes, Frequency distribution, mean, median & mode, standard deviation, X-R charts, P-Charts, C-Charts and acceptance sampling (i) I.S.O. 9000 (ii) KAIZEN (iii) Six Sigma (iv) 5S (v) TQM system, concept & brief idea only .

### UNIT 2:

**WORK STUDY** Method study-Process chart, Flow process chart, Flow diagram, Man and Machine chart, gang process chart, Work Measurement-Time study, Tools used in time study, Performance rating, Allowance and use of time standard, Time and Motion Study. Principles of human motion economy, Micro-motion study, Memo motion study, Therbligs, left hand and right hand chart.

### UNIT 3:

**CPM & PERT** Introduction to CPM, language of CPM network, Diagram map for CPM chart, arrow diagram method of CPM, Programme Evaluation & Review Technique (PERT) Activity event network (simple manual cases only). Project scheduling with CPM & PERT

### UNIT 4:

**PLANT LAYOUT** General Plant location factors, Influence of location on plant layout, selection of plant site, Product layout, Process layout. Advantages and disadvantages of process layout and product layout, **GENERAL:** Standardization, sources of standard, value of standardization. Production Planning & Control-Introduction, concept of planning, scheduling routing & dispatching and follow up functions, Need for Production, Planning and Control.

### UNIT 5:

**MATERIAL HANDLING** Material Handling & material handling equipment, factors in material handling problems, cost reduction through improved material handling, Reduction in time of material handling, Material handling equipment-Idea about lifting lowering devices, Transportation devices, combination devices, Maintenance of material handling equipment.

### Reference Books:

1. Industrial Engineering and Management, S.C. Sharma, Khanna Publishing House
2. Industrial Safety, S.C. Sharma, Khanna Publishing House
3. Industrial Engineering & Management: Banga, Sharma & Agrawal
4. Industrial Engineering Safety & Pollution (Hindi): HemendraDutt

### Project

On the basis of learning in the vocational diploma, a project to be taken up by the student strengthening his/ her vocational skills

## Engineering Graphics

## **1. Introduction**

Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used toolbars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.

## **2. Orthographic Projections**

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes

## **3. Orthographic Projections of Plane Surfaces (First Angle Projection Only)**

Introduction, Definitions—projections of plane surfaces—triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only.

## **4. Projections of Solids (First Angle Projection Only)**

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.

## **5. Sections and Development of Lateral Surfaces of Solids**

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.

## **6. Isometric Projection (Using Isometric Scale Only)**

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of Tetrahedron, hexahedron (cube), right regular prisms, pyramids, cylinders, cones, spheres, cut Spheres.

### **Reference Books:**

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, 48th edition, 2005-Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition- 2006.
3. Engineering Graphics - K.R. Gopalakrishna, 32nd edition, 2005- Subash Publishers Bangalore.
4. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, 2005-Prentice-Hall of India Pvt. Ltd., New Delhi.

## Mechanical Workshop Practice

1. SHEET METAL WORKING AND SOLDERING:
  - a. (EX-1) Cutting, shearing and bending of sheet.
  - b. (EX-2) To prepare a soap case by the metal sheet
  - c. (EX-3) To make a funnel with thin sheet and to solder the seam of the same
  - d. (EX-4) To make a cylinder and to solder the same
  
2. FITTING SHOP WORK:
  - a. (EX-1) Hack sawing and chipping of M.S. flat
  - b. (EX-2) Filing and squaring of chipped M.S. job
  - c. (EX-3) Filing on square of rectangular M.S. Plate
  - d. (EX-4) Drill a hole in MS Block & tapping the same
  - e. (EX-5) Making a Bolt & Nut by Tap & Die set.
  
3. SMITHY SHOP WORK:
  - a. (EX-1) To prepare square angular piece by M.S. rod
  - b. (EX-2) To make square or hexagonal head bolt
  - c. (EX-3) To make a screw driver with metallic handle
  - d. (EX-4) To make ring with hook
  
4. Tin Smithy, Soldering, Brazing
  - a. (EX-1) To prepare different types of joint such as lap joint single seam, double seam & cap joint-hem & wired edge.
  - b. (EX-2) Utility article-waste paper basket or paper tray
  - c. (EX-3) Study & sketch stakes / anvils.
  
5. WELDING SHOP WORK:
  - a. (EX-1) Welding practice gas & electric arc welding
  - b. (EX-2) Welding for lap joint after preparing the edge
  - c. (EX-3) Welding Butt joint after preparing the edge
  - d. (EX-4) Gas Cutting
  - e. (EX-5) 'T' joint welding after preparation of edge.

### Reference Books:

1. Workshop Technology, Vol. I: Hazra& Chaudhry
2. Elements of Workshop Technology Vol. I: BS Raghuwanshi

## Level 6 (Semester III)

### Tool Engineering - I

#### Unit 1

##### Introduction:

Concept, meaning and definitions of tool, tool design and tool engineering, Tools-types, classification, features & applications, Tool engineering- functions and importance to enhance productivity and quality, Importance of process planning in tool engineering, Economy-concept, meaning, importance and principles in tool engineering.

#### Unit 2

**Cutting tools:** Cutting tool materials-types, composition, properties and applications, Carbide inserts-types, ISO-designation and applications, Re-sharpening methods of following cutting tools: i. Drill. ii. Side and face milling cutter. iii. End mill. iv. Centre drill etc.

#### Unit 3

**Press tools:** Press working processes-types, sketches and applications, Press tools: types, working, components and their functions, Concept, meaning, definitions and calculations of press tonnage and shut height of press tool, Shear action in die cutting operation, Centre of pressure: Concept, meaning, definition, methods of finding and importance, Die clearance: Concept, meaning, definition, reasons, effects and methods of application, Scrap strip layout: - Concept, importance, method to prepare, and determining percentage stock utilization, Types, working, and applications of stock stop, pilots, strippers and knockouts, Cutting dies-types and applications.

#### Unit 4

**Dies and moulds:** Bending: Types, Parts and functions of bending die, Definition, calculations and factors affecting bend radii, bend allowance and spring back, Method to compute bending pressure, Types, sketch, working and applications of bending dies. Drawing dies-types and method to determine blank size for drawing operation, Types, sketch, working and applications of drawing dies (embossing, curling, bulging, coining, swaging and hole flanging), Forging dies- terminology, types, sketch, working and applications, Dies / Mould: Sketch, working and applications of following i. Extrusion. ii. Plastic injection. iii. Blow moulding

##### Reference Books:

1. Tool Engineering ,Albert A Dowd

## **Production Automation & Computer Integrating Manufacturing**

**UNIT 1-General:** Automation-Definition, Scope, its types and their merits, reasons for automation, its appreciation and criticism, Meaning of the term Computer Integrated Manufacturing (CIM CAD/ CAM) Relationship between CIM and Automation **FUNDAMENTALS OF MANUFACTURING AND AUTOMATION:** Types of Industries- Manufacturing, Processing; Basic producers, Converter, Fabricators. Types of Production-Job shop production, Batch production Mass production (Quantity Production and Flow production).Manufacturing - Functions - Processing - Basic processing, Secondary processing; Operations enhancing physical properties and finishing operations, Assembly, Material handling and Storage; Inspection and test and control, their meaning with automation point of view, Automation of welding Manufacturing Process Inputs - Raw materials, Equipments (Machine Tools), Tooling and fixtures, Energy and Labour, Outputs - Finished product and Scrape/Waste. Plant Layout - Its meaning and concept of fixed position layout, Process Layout, Product layout and Group technology layout, Organisation and Information Processing Business functions, Product design, Manufacturing planning and Manufacturing control

**UNIT 2 -Production Concept:** Such as Manufacturing Lead Time (MLT), Production rate, Components of Operation Time, Production Capacity (PC), Utilisation and availability, Work in Process (WIP), Time in Plant (Tip), WIP Ratio, Tip ratio, their meaning and significance. Simple numerical problems Automation Strategies and Their Effect - Specification of operation, Combined operations, Simultaneous operations, Integration operations, Increase flexibility, Improved material handling and storage, on-line inspection, process control and optimization, Plant operation control, computer integrated manufacturing. **PRODUCTION ECONOMICS:** Methods evaluation investment alternatives, Constraints in manufacturing, Break Even Analysis, Unit Cost of Production, Cost of manufacturing, lead time and work in process.

**UNIT 3Assembly System And Line Balancing:**The assembly process, Assembly system, Manual assembly lines, Line balancing problems, Computerised line, balancing methods, Other ways to improve the line balancing, flexible manual assembly line **AUTOMATED ASSEMBLY SYSTEMS:** Design for automated assembly, Types of automated assembly systems, Parts feeding devices, analysis of multi-station Assembly machines, Analysis of single station assembly machines

### **UNIT 4:**

**Numerical Control Production System:**Numerical controlling, Coordinate system, and Machine motions, Types of N.C. systems, Machine tool applications, Economics of NCS

### **UNIT 5**

**N.C. Part Programming:** Tape and Tape format, Methods of N.C. part programming, Computer assisted part programming, The APT Language, Manual data inputs, N.C. part programming using CAD/CAM and Computer automated part programming. **DNC, CNC & ADAPTIVE CONTROL:** Direct Numerical Control (DNC), Computer Numerical control (CNC), Adaptive Control Machining, Current trends in N.C., introductory idea of FMS (Flexible Manufacturing System)

### **Reference Books:**

1. Numerical Control Machines: NK Mehta
2. Production Automation & Computer Integrated Manufacturing: MP Groover

## Fundamentals of Mechatronics

**1. Introduction:** Introduction to mechatronics, systems, measurement systems, control systems, the mechatronics approach. Introduction to Transducers: Sensors and transducers, operating characteristics of transducers, measurement of displacement, velocity, pressure, flow, and temperature.

**2. Signal conditioning:** Signal conditioning- their features and various blocks, the operational amplifiers, Protection, Filtering, Wheatstone bridge, Digital signals, Multiplexers, Data acquisition, Digital signal processing. Data Presentation Systems: Displays, Data presentation elements, Magnetic recording, Displays, Data acquisition system, Telemetry- electrical, optical and pneumatic methods of telemetry.

**3. Introduction to process control systems:** Importance of process control, analog and digital processing, Supervisory digital control, direct digital control. Controller Characteristics: Process characteristics, control system parameters, Discontinuous controller modes (two position, multiple position, floating position), Continuous controller modes i.e. P, I, D, PI, PD, PID.

**4. Introduction of Mechanical Actuation Systems:** Mechanical Actuation Systems for motion, Kinematics chains, Cams, Gear trains, Belt and chain drives, Bearings. Pneumatic and Hydraulic Systems: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure control valves, Cylinders, Process control valves, rotary actuators.

**5. Introduction of Electrical Actuation Systems:** Electrical systems, Mechanical Switches, Solid-state switches, Solenoids, DC motors, AC motors, Stepper motors.

### Reference Books:

1. Mechatronics: A Multidisciplinary Approach, by William Bolton
2. Mechatronic Systems: Fundamentals, by R. Isermann

## Machining and Machine Tools

**1. Classification of Metal Removal Process and Machines Mechanics of Metal Cutting:** Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS, NRS and interrelationship, introduction of mechanism of chip formation and types of chips, chip breakers, orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting, thermal aspects of machining and measurement of chip tool interface temperature, friction in metal cutting.

**2. Machinability:** Concept and evaluation of machinability, tool life, mechanisms of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability, Cutting fluids, types, properties, selection and application methods, General Purpose Machine Tools: tooling, attachments and operations performed, selection of cutting parameters, Simple calculation of time for machining.

**3. Special Purpose Machine Tools:** Automatic lathes, capstan and turret lathe machines, tracer attachment in machine tools, mechanical-copying machines, Hydraulic tracing Devices, Electric tracing systems, Automatic tracing, Abrasive Processes: Abrasives, natural and synthetic, manufacturing, nomenclature, selection of grinding wheels, wheel mounting and dressing, characteristic terms used in grinding, machines for surface and cylindrical grinding, their constructional details and processes, surface finishing, honing, lapping, super finishing, polishing and buffing processes.

**4. Thread and Gear Manufacturing:** Casting, thread chasing, thread cutting on lathe, thread rolling, die threading and tapping, thread milling, thread grinding, Gear Manufacturing Processes: Hot rolling, stamping, powder metallurgy, extruding etc. gear generating processes, gear hobbling, gear shaping, gear finishing processes, shaving, grinding, lapping, shot blasting, phosphate coating, gear testing.

**5. High Velocity Forming Methods:** (High-energy rate forming processes) Definition, Hydraulic forming, explosive forming, electro- hydraulic forming, magnetic pulse forming

### Reference Books:

1. Machine Design, Sadhu Singh, Khanna Publishing House
2. Machine Design Data Book, Sadhu Singh, Khanna Publishing House



### **Tool Engineering Lab**

1. Study of the influence of tool geometry on surface integrity
  - a. With positive rake angle
  - b. With negative rake angle
2. Effect of speed, feed, depth of cut and nose radius on surface topography of the components machined using tool inserts
3. Cutting force measurement and construction of Merchant circle diagram as a function of rakeangle
4. Study of different type of chips
5. Tool tip temperature measurement during turning of heat treated and cast products
6. Machinability studies on different materials (for different conditions)
7. Machining of the heat treated samples
8. Machining of as-cast product
9. Measurement of tool wear of inserts due to machining

### **Mechatronics Lab**

1. Displacement Measurement using Capacitive & inductive Pick-ups.
2. Study of Speed Measurement System: (a) Magnetic Pick-up (b)Stroboscope
3. Study of Load Measurement System Load Cell
4. Measurement of temperature using thermocouple, thermistor and RTD
5. Measurement of displacement using POT, LVDT & Capacitive transducer
6. Torque measurement using torque measuring devices
7. Strain Measurement using strain gauge
8. Frequency to Voltage Converter and vice versa
9. Position and velocity measurement using encoders
10. Study on the application of data acquisition system for industrial purposes

## Level 6 (Semester IV)

### Tool Engineering – II

#### Unit 1.

**Tool holders:** Tool holders for turning and milling carbide inserts-types, ISO-designation and applications, Tool holding and tool mounting systems for conventional milling and drilling machine tools.

#### Unit 2.

**Locating and clamping devices:** Concept, meaning and definitions of location and clamping, Use of locating and clamping principles in day-to-day supervision on shop floor, Degree of freedom-concept and importance, 3-2-1 principle of location, Locators-Types, Sketches with nomenclature, Working, Applications, Fool proofing and ejecting

#### Unit 3.

**Clamping devices:** Types, Sketches with nomenclature, Working, Applications

#### Unit 4.

**Jigs and fixtures:** Concept, meaning, differences and benefits of jigs and fixtures, Types, sketches with nomenclature, working and applications of jigs, Types, sketches with nomenclature, working and applications of fixtures.

#### Unit 5.

**Design of Jigs and Fixtures:** Steps in designing jigs and fixture for given simple component

#### Reference Books:

1. Tool Engineering BY Albert A Dowd

## Lean and Agile Manufacturing

### Unit 1.

**Introduction-** Introduction to Just in time production, Toyota production system, Introduction to lean manufacturing (LM), history of LM, advantages of LM over mass production

### Unit 2.

**Waste Identification-** Types of wastes, lean manufacturing principles; Value, value stream, flow, pull and perfection

### Unit 3.

**Value stream mapping-** Introduction to value stream mapping, types of value stream mapping, value added activities, necessary non value added activities, non-value added activities

### Unit 4.

**Lean manufacturing tools-** Introduction to 5S, Kanban, kaizen, work standardization, Statistical process control, automation and other lean tools

### Unit 5.

**Agile manufacturing-** Introduction to agile manufacturing, advantages of agile manufacturing, differences with lean manufacturing.

### Reference Books:

1. Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities,Devadasan S.R
2. Learning Agile: Understanding Scrum, XP, Lean, and Kanban,Andrew Stellman, Jennifer Greene

## **Metal Forming Processes**

### **Unit 1.**

**Rolling-** Introduction, Types of rolling, Hot rolling, Two high reversing mill, Three high mill, Continuous mill, Roll bending

### **Unit 2.**

**Forging-** Introduction, Advantages of Forging, Application of Forging, Limitations of Forging, Upsetting, Hollow Forging, Impression die or closed, Methods of Forging, Drop Forging, Press Forging, Hammer and press Forging, Hot bar Forging, Upset Forging

### **Unit 3.**

**Extrusion-** Direct and forward, Sleeve method of direct, Indirect or backward, Impact Extrusion, Tube Extrusion, Stepped Extrusion, Combined forging and Extrusion

### **Unit 4.**

**Drawing-** Wire Drawing, Cupping and Bending, Tube Drawing, Spinning, Hot and cold Spinning  
Advantages of Metal Spinning

### **Unit 5.**

**Pipe and Tube Production-** Manufacturing of seamless pipe- Butt welded pipe- Lap welded pipe

### **Reference Books:**

1. Sheet Metal Forming Processes: Constitutive Modelling and Numerical Simulation, D. Banabic
2. Metal Forming Processes, G. R. Nagpal

## Mass Production Devices

### Unit 1.

**Introduction-** Properties of tool material, types of tool material, 5 basic requirement of tool material and general consideration in tool design, Tools-types, classification, features & applications

### Unit 2.

**Design of Cutting Tools-** Geometry and features of Single point tool, Boring tool, Twist Drill, Milling cutter, Broaches. Carbide inserts-types, ISO-designation and applications.

### Unit 3.

**Press Tools-** Introduction to Press tools, Elements of press tools - punches, punch holder, knockouts, pilots stock, Types of punches, Standards die sets, Element of blanking die, Element of drawing die, Element of bending die, Working of progressive and compound dies

### Unit 4.

**Jig & Fixtures-I-** Usefulness, Principles of Jig & Fixtures design, Principle of location, Locating and clamping devices 5. **Jig & Fixtures-II-** Type of jigs, Element of a fixture, Milling fixtures, Lathe fixture, Economics of jigs and fixtures

### Reference Books:

1. Mass Production, phaidon

### **Tool & Die Making Lab**

1. Manufacture of Box Jig and Angle plate jig
2. Manufacture of “V” Block angle grinding Fixtures and profile milling fixture
3. Manufacture of simple Blanking & piercing Tool
4. Manufacture of Progressive tool for producing a Cycle chain link
5. Manufacture of Press tools like Combination tool & Compound tool
6. Manufacture of Draw tool
7. Trial out On Fly press and power press the Produced components such as V, U, Cycle link, Cup, Washer and Cycle bell cup
8. Manufacture of simple V and U bending tool
9. Maintenance of Jig& fixture and press tool

### **IT Tools Lab.**

1. Spreadsheets, Word, Presentation
2. Multimedia Design
3. Troubleshooting
4. Project / Practical File
5. Viva Voce

## Level 7 (Semester I)

### Reliability, Maintenance and Safety

#### Engineering

##### Unit 1

**Reliability-** Definition, reliability function, Mean failure rate, mean time to failure (MTTF), mean time between failures (MTBF), hazard rate curve. Bathtub curve, Conditional Reliability

##### Unit 2

**Constant Failure rate model-** Exponential Reliability function, Failure Modes, CFR model, memory lessens, System reliability: Series, parallel, mixed & complex configuration; Reliability improvement.

##### Unit 3

**Design for reliability-** Reliability specifications and system Measurements, System Effectiveness, redundancy, Classification of Redundancy. Introduction of failure mode and effect analysis (FMEA)

##### Unit 4

**Maintainability-** Analysis of Downtime, repair time distribution, stochastic point processes.

##### Unit 5

**Safety engineering-** Fundamentals of industrial safety, Safety policy and safety terminology, Different types of safety systems and equipments, Safety targets, standards, objectives.

##### Reference Books:

1. Reliability Engineering, S.C. Sharma, Khanna Publishing House
2. Reliability, Maintenance and Safety Engineering, A.K. Gupta

## Design Concepts in Engineering

**1. Design Fundamentals:** Importance of design- The design process-Considerations of Good Design– Morphology of Design –Organization for design– Computer Aided Engineering – Designing to codes and standards – Concurrent Engineering – Product and process cycles – Technological Forecasting – Market Identification – Competition Bench marking.

**2. Customer Oriented Design & Societal Considerations:** Identification of customer needs- customer requirements- Quality Function Deployment- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

**3. Design Methods:** Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving (TRIZ)–Conceptual decomposition-Generating design concepts-Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture-Configuration Design- Parametric Design. Role of models in design-Mathematical Modelling – Simulation – Geometric Modelling –Rapid prototyping- Finite Element Analysis– Optimization – Search Methods

**4. Material Selection Processing and Design:** Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly–Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

### Reference Books:

1. Design concepts for engineers,Mark N. Horenstein
2. Concepts in Engineering Design,Sumesh Krishnan, Dr.Mukul Shukla



## Product Design and Development

### Unit 1.

**Importance of New Product:** Definition-importance-Development Process, Importance of new product for growth of enterprise, Definition of product and new product, Responsibility for new product development, Demands on product development team, Classification of products from new product development point of view. New product development process and organization, Generic product development process for Market Pull Products, Modification of this process for other types of products.

### Unit 2.

**Need Analysis:** Problem formulation establishing economic existence of need, need identification and analysis, engineering statement of problem, establishing target specification

### Unit 3.

**Generation of Alternatives and Concept Selection:** Concept generation- a creative process, Creativity, Road Elects to creative thinking Fear of criticism and Psychological set, Tools of creativity like brain storming, Analogy, Inversion etc., Creative thinking Process, Concept feasibility and Concept Selection, Establishing Engineering Specification of Products.

### Unit 4.

**Preliminary and Detailed Design:** Design Review Preliminary design- Identification of subsystems, Subsystem specifications, Compatibility, Detailed design of subsystems, component design, Preparation of assembly drawings, Review of product design from point of view of Manufacturing, Ergonomics and aesthetics.

### Unit 5

#### **Assembly drawing and review**

Preparation of assembly drawings, Review of product design from point of view of Manufacturing, Ergonomics and aesthetics

#### **Reference Books:**

1. Manufacturing Processes for Design Professionals, Rob Thompson
2. Product design for manufacture and assembly, Geoffrey Boothroyd

## CAD & CAM

### Unit 1

#### Introduction CIM and CAD & Analysis:

CIM: Introduction of CIM– concept of CIM - evolution of CIM – CIM wheel –Benefits – integrated CAD/CAM. CAD: Introduction– CAD definition – Shigley’s design process – CAD activities – benefits of CAD. Types of CAD systems, CAD software packages, 2D & 3D transformations, Geometric modeling: Techniques: Wire frame modeling – surface modeling – solid modeling

### Unit 2

#### Computer aided Manufacturing CAM:

Definition, functions, benefits. Group technology – Part families - Parts classification and coding - coding structure – Optiz system, MICLASS system and CODE System - process planning – CAPP – Types of CAPP: Variant type, Generative type – advantages of CAPP – production planning and control – computer integrated production management system – Master Production Schedule (MPS) – Capacity planning – Materials Requirement Planning (MRP) –Manufacturing Resources Planning (MRP-II)

### Unit 3

#### CNC Machine and Components:

CNC Machines: Numerical control – definition – components of NC systems – development of NC – DNC – Adaptive control systems – working principle of a CNC system – Features of CNC machines - advantage of CNC machines – difference between NC and CNC – Construction and working principle of turning centre – Construction and working principle of machining centers – machine axes conventions turning centre and machining centre – design considerations of NC machine tools.

### Unit 4

#### Part Programming

NC part programming – methods – manual programming – conversational programming – APT programming - Format: sequential and word address formats - sequence number – coordinate system – types of motion control: point-to-point, paraxial and contouring – Datum points: machine zero, work zero, tool zero NC dimensioning – reference points – tool material – tool inserts - tool offsets and compensation - NC dimensioning – preparatory functions and G codes, miscellaneous functions and M codes – interpolation: linear interpolation and circular interpolation.

### Unit 5

#### FMS, Integrated Material Handling and Robot:

Types of manufacturing - introduction to FMS – FMS components – FMS layouts – Types of FMS: flexible manufacturing cell – flexible turning cell – flexible transfer line – flexible machining systems – benefits of FMS - introduction to intelligent manufacturing system – virtual machining. Computer Integrated material handling – AGV: working principle – types, benefits – Automatic Storage and Retrieval Systems (ASRS). ROBOT – definition – robot configurations – basic robot motion – robot programming method – robotic sensors - industrial applications: characteristics, material transfer, machine loading, welding, spray coating, assembly and inspection.

#### Reference Books:

1. Engineering AutoCAD, Pradeep Jain & A.P. Gautam, Khanna Publishing House
2. Engineering Graphics and Design, Pradeep Jain & A.P. Gautam, Khanna Publishing House

### **CAD Lab**

1. Introduction and different features of the CAD Software.
2. 2-D Drafting.
3. 3-D Modeling.
4. 3-D Advanced Modeling.
5. Assembly modeling.
6. Feature Modification and Manipulation
7. Detailing.
8. Sheet Metal Operations.
9. Surface Modeling.

### **CAM Lab**

1. To prepare part programming for plain turning operation.
2. To prepare part programming for turning operation in absolute mode.
3. To prepare part program in inch mode for plain turning operation.
4. To prepare part program for taper turning operation.
5. To prepare part program for turning operations using turning cycle.
6. To prepare part program for threading operation.
7. To prepare part program for slot milling operation.
8. To prepare part program for gear cutting operation.
9. To prepare part program for gear cutting using mill cycle.
10. To prepare part program for drilling operation

## Level 7 (Semester VI)

### Rapid Prototyping and Reverse Engineering

#### Unit 1

##### Introduction

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

#### Unit 2

##### CAD Modelling and Data Processing for RP

CAD model preparation, Data Requirements, different types of Data formats, Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

#### Unit 3

##### RP Systems

Photo-polymerization process, Powder Bed Fusion process, Applications of Powder Bed Fusion Processes. Extrusion - Based RP Systems, 3D Printing process modelling, Applications of Printing Processes. Sheet Lamination process /Laminated Object Manufacturing (LOM), Beam Deposition: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing - structure-properties, relationships, Benefits and drawbacks.

#### Unit 4

##### Rapid Tooling:

Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

#### Unit 5

##### RP Applications:

Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP

##### Reference Books:

1. Rapid Product Development, Kimura Fumihiko

## Process Planning and Cost Estimation

**Unit 1. Introduction to Process Planning: Process Planning**—Definition, Purpose of Process Planning, Concept of Process Planning, Objectives of Process Planning, Scope of Process Planning, and Information required to do Process Planning, Preparing Operation Planning Sheet

**Unit 2. Process Planning activities:** Process Planning Procedure, Approaches of Process Planning, Manual Process Planning, Computer Aided Process Planning, Factors Affecting Selection Process, Machine Capacity, Determination of Man, Machine and Material Requirements, Factors Influencing Choice of Machinery

**Unit 3. Introduction to Cost Estimation:** Reasons for doing Estimates, Importance of Estimating, Objectives or Purpose of Estimating, Functions of Estimating, Cost Accounting of Costing, Importance of Costing, Aims of Cost Accounting, Difference between Cost Estimating and Cost Accounting, Cost of Product (Ladder of Cost) Production Cost Estimation, Determination of Material Cost, Mensuration in Estimating

**Unit 4. Machining Time Calculation:** Selection of Cutting Speed, Feed and Depth of Cut for Turning: Machining Time Calculation for Turning Operation. Selection of Cutting Speed, Feed and Depth of Cut for Milling Operation: Machining Time Calculation for Milling Operation. Selection of Cutting Speed, Feed Depth of Cut for Drilling Operation: Machining Time Calculation for Drilling Operation

### Reference Books:

1. Process Planning And Cost Estimation, Panneerselvam R., Sivasankaran P.
2. Process Planning and Cost Estimation, B. Vijayaramanath, C. Elanchezhian, R. Kesavan

### Project

On the basis of learning in the B.Voc. Programme, i.e. Level 5 to Level 7, a project to be taken up by the student strengthening his/ her vocational skills.

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc**

**Refrigeration and Air conditioning (RC)**

**Branch Code: 105**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

**Evaluation Scheme**  
**B. Voc Refrigeration and Air conditioning**

NSFQ Level 5 SEMESTER- I											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BRCV511	Basics of Refrigeration	30	10	5	5	20	30		50	2
2	BRCV512	Basics of Air Conditioning	30	10	5	5	20	30		50	2
3	BRCV513	Engineering Material	30	10	5	5	20	30		50	2
4	BRCV514	Soldering & De-Soldering of Components & Emergency actions	30	10	5	5	20	30		50	2
5	BRCP511	Metrology and Measuring Instruments Lab	30				20		30	50	1
6	BRCP512	Heat Transfer lab.	30				20		30	50	1
7	BRCP513	Language Lab	30				20		30	50	2
8	BRCT511	Field Technician- AC (ELE/Q 3102)						Any one Training 400 hrs/ 8 weeks	150	12	
	BRCT512	Field Technician- Refrigeration (ELE/Q 3103)									
	BRCT513	Field Engineer- RACW (ELE/Q3105)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 5 SEMESTER- II											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BRCV521	Industrial Management	30	10	5	5	20	30		50	2
2	BRCV522	Total Quality Management	30	10	5	5	20	30		50	2
3	BRCV523	Entrepreneurship	30	10	5	5	20	30		50	2
4	BRCV524	Refrigeration & Air Conditioning Applications	30	10	5	5	20	30		50	2
5	BRCP521	Project -1	30				20		30	50	1
6	BRCP522	Basic Electrical and Electronics Lab	30				20		30	50	1
7	BRCP523	IT Tools Lab	30				20		30	50	2
8	BRCT521	Field Technician- AC (ELE/Q 3102)						Any one Training (other than 1 <sup>st</sup> sem) 400 hrs/ 8 weeks	150	12	
	BRCT522	Field Technician- Refrigeration (ELE/Q 3103)									
	BRCT523	Field Engineer- RACW (ELE/Q3105)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

NSFQ Level 6 SEMESTER- III											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BRCV631	RAC Piping Systems - I	30	10	5	5	20	30		50	2
2	BRCV632	Refrigeration & Air-conditioning Material -I	30	10	5	5	20	30		50	2
3	BRCV633	Refrigerants	30	10	5	5	20	30		50	2
4	BRCV634	RAC Standards	30	10	5	5	20	30		50	2
5	BKV631	Uni. Human Values & Ethics	30	10	5	5	20	30		50	2
6	BRCP631	RAC Material Lab	30				20		30	50	1
7	BRCP632	RAC Systems Installation and its Maintenance Lab. - I	30				20		30	50	1
8	BRCT631	Safety Tester – RACWO (ELE/Q3605)					Any one Training 400 hrs/ 8 weeks			150	12
	BRCT632	Field Engineer – RACW (ELE/Q3105)									
	BRCT633	Cold Storage Technician (FIC/Q7004)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 6 SEMESTER- IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BRCV641	RAC Piping Systems - II	30	10	5	5	20	30		50	2
2	BRCV642	Refrigeration & Air-conditioning Material-II	30	10	5	5	20	30		50	2
3	BRCV643	RAC Maintenance - I	30	10	5	5	20	30		50	2
4	BRCV644	RAC Installation Techniques - I	30	10	5	5	20	30		50	2
5	BKVE641	Environment and Ecology	30	10	5	5	20	30		50	2
6	BRCP641	RAC Systems Installation and its Maintenance Lab. - II	30				20		30	50	1
7	BRCP642	RAC Piping Systems Lab	30				20		30	50	1
8	BRCT641	Safety Tester – RACWO (ELE/Q3605)					Any one Training (other than 3rd sem) 400 hrs/ 8 weeks			150	12
	BRCT642	Field Engineer – RACW (ELE/Q3105)									
	BRCT643	Cold Storage Technician (FIC/Q7004)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

GV: General Vocational; VP: Vocational Practical; OJT: On Job Training; SSC: Sector Skill Council



NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BRCV751	RAC Maintenance - II	30	10	5	5	20	30		50	2
2	BRCV752	RAC Installation Techniques - II	30	10	5	5	20	30		50	2
3	BRCV753	Automobile Air conditioning	30	10	5	5	20	30		50	2
4	BRCV754	Non-conventional Refrigerating System	30	10	5	5	20	30		50	2
5	BKVH751	Constitution of India, Law and Engineering	30	10	5	5	20	30		50	2
6	BRCP751	RAC Maintenance - II	30				20		30	50	1
7	BRCP752	RAC Installation Techniques - II	30				20		30	50	1
8	BRCT751	AC Specialist – Automobile (ASC/Q 1416)					Any one Training 400 hrs/ 8 weeks			150	12
	BRCT752	Assembly Operator (ELE/ Q 3501)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BRCV761	RAC Safety	45	10	5	5	20	30		50	2
2	BRCV762	Process Planning and Cost Estimation	45	10	5	5	20	30		50	2
3	BKVH761	Indian Tradition, Culture and Society	30	10	5	5	20	30		50	2
4	BRCP761	Major Project	180						150	150	6
5	BRCT761	AC Specialist – Automobile (ASC/Q 1416)					Any one Training (other than 5 <sup>th</sup> sem) 400 hrs/ 8 weeks			200	12
	BRCT762	Assembly Operator (ELE/ Q 3501)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

## Level 5 (Semester 1)

### Bridge Course

**Steam Generators:** Types of steam generators - Fire tube, water tube boilers, boiler mountings and accessories, Equivalent evaporation, boiler efficiency, elements of power plant.

**Reciprocating Steam Engines:** Working principles, classification, a brief idea and concept only.

**Steam Turbines:** Classification, principle of operation of Impulse reaction steam turbines.

**Steam Condensers:** Principle of operation, classification, a brief concept, condenser details, applications

**Air Compressors:** Definition and their use, Difference between reciprocating and rotary compressors, their types and working, Inter cooling in two stage compression volumetric efficiency, Compressor lubrication. Simple numerical problems.

**Basic Thermodynamics:** Definition, concept of thermodynamic system and surroundings, closed system, open system, isolated system thermodynamics, definition of work, Zeroth law of thermodynamics, First law of thermodynamics for cyclic and noncyclical processes, Idea of internal energy and enthalpy, Applicability of first law on various thermodynamics processes, simple numerical problems.

**Steady state flow process,** its equation and its applications: Second law of thermodynamics, Thermodynamics concept of perpetual motion machine of first order and that of second order, Concept of heat engine, heat pump and refrigerator, Carnot cycle efficiency for heat engine and C.O.P for refrigerator and heat pump, Entropy: Its physical concept and significance.

## **Basics of Refrigeration**

### **Unit 1**

INTRODUCTION: Its meaning and application, unit of refrigeration; Various methods of refrigeration.

### **Unit 2**

REFRIGERATION SYSTEMS: Refrigeration Cycles: Refrigeration, Carnot cycle of refrigeration (ideal cycle), Bell-Coleman cycle of refrigeration, their COP and Conditions for its highest value, Temperature limitations. Representation of these cycles, in P-V, T-S and P-H diagrams and also their flow diagrams, Simple numerical problems .

### **Unit 3**

Vapour compression system: Standard vapour compression cycle, wet and dry compression, Effect of sub cooling and super heating, Effect of temperature and pressure on COP of the cycle. Simple numerical problems with the help of P-H diagram. Concept of house hold refrigerator working on vapour compression cycle.

### **Unit 4**

Vapour Absorption System: Cycle of operation, Construction and working of refrigerator based on this system. Simple numerical problems (Simple line diagram)

### **Unit 5**

REFRIGERANTS: Definition, classification & properties of few important refrigerants such as Ammonia, Sulphur-Di-Oxide (SO<sub>2</sub>) Carbon-Di-Oxide (CO<sub>2</sub>) Freon -12 (F-12) F-11. Qualities of good refrigerants, secondary refrigerant .

### **Suggested Reading:**

Refrigeration and Air Conditioning: A Sarao

Refrigeration and Air Conditioning: RS Khurmi

## Basics of Air Conditioning

### Unit 1

INTRODUCTION: Its meaning and general application. Psychrometry: Definition, Composition of air, Daltons law of partial pressure, Gas and Vapour mixture, Dry and Wet bulb temperature, Wet bulb depression, Dew point, Dew point depression, Saturated air,

### Unit 2

Specific humidity, Degree of saturation, Relative humidity, Absolute humidity, Humid specific volume and humid specific heat, Enthalpy of moist air,

### Unit 3

Use of psychometric charts and tables, Sensible heating and cooling, Humidification and dehumidification and their methods, Simple numerical problems concerning above

### Unit 4

HEAT LOAD: Brief idea of various types of heat loads, Sensible and latent heat loads. Sensible hat factor

### Unit 5

ROOM AIR CONDITIONING: Brief idea of room air conditioning, Window types packaged air conditioner. Central air conditioning system, Round the year air conditioning

### Suggested Reading:

Refrigeration and Air Conditioning: A Sarao

Refrigeration and Air Conditioning: RS Khurmi

## Engineering Material

### UNIT 1

#### ELECTRICAL ENGINEERING MATERIALS

Conducting Materials: Properties of good conducting materials, Brief idea about conductivity & Resistivity

### UNIT 2

(a) Insulating Materials: (a) Plastic insulating materials-definition and classification, thermo-setting and thermoplastic materials, their applications and commercial names & uses in industry. (b) Various insulating materials-mica asbestos, ceramic materials, glass, cotton, silk, jute, paper their properties and applications

(B) Semiconductor Materials: Characteristics and applications of semiconductor materials

### UNIT 3

(A) Non-Metallic Materials-Timber. Preservation of timber, Defects of timber, Surface treatment, Plywood, Hard Board, Batten Board, Veneer board, units of purchase

(B) Miscellaneous Materials: Important properties, characteristics and use of the following materials: Abrasives, Asbestos, Celluloid, Cork, Mica, Refractory

### UNIT 4: Mechanical Engineering Materials

Non-Ferrous Metals: Aluminium, Zinc, Copper, Tin, Silver, Lead - Trade names; Physical, mechanical, and electrical properties and use

(ii) Base metal with principal alloying elements - Aluminium Alloys, Copper Alloys, Nickel Alloys, Bearing Metals- Lead base alloys, Tin base alloys, (White metals or babbitt metals), Copper base alloys.

### UNIT 5: Civil Engineering Materials

General idea of raw materials, properties and uses of Bricks, lime, cement

Foundation: (i) Bearing capacity of soil and its importance, need of foundation for machines (ii) Foundations for heavy, light and vibrating machines (iii) Concrete proportion, mixing w/c ratio, workability RCC and its use.

#### Suggested Reading:

Engineering Materials: Dhanpat Rai & Sons

Electrical Engineering Materials: Madan Publishers

## **Soldering & De-soldering components & Emergency actions**

### **1. Soldering & De Soldering of Basic Components**

- Soldering Tools
- Different types of Soldering Guns related to Temperature and wattages, types of tips
- Solder materials and their grading
- Soldering and De Soldering Stations and their Specifications
- Preparing Component for Soldering
- PCB Applications
- Types of PCB
- Soldering Basic Components on PCB
- De soldering Basic Components
- Safety precautions while Soldering & De soldering
- Check for cold continuity of PCB
- Identification of loose/dry solder, broken tracks on printed wire assemblies & discrete components mounted circuit boards
- Join the broken PCB track and test
- De soldering using Pump and wick
- Introduction of SMD Components

### **2. Introduction to SMD Components**

- Identification of 2, 3, 4 terminal SMD components
- Soldering the SMD components on the PCB
- Make the necessary settings on SMD soldering station to solder various ICs of different packages by choosing proper clamping tools
- Identify various connections and the setup required for SMD soldering station
- De solder the SMD components from the given PCB
- Make the necessary settings on SMD soldering station to de solder various ICs of different packages by choosing proper clamping tools
- Make a panel board using different types of switches for a given application
- Identification of crimping tools for various IC packages
- Reliable Soldering Practices

### **3. Emergency actions**

- Minimum Requirements

### **Metrology and Measuring Instruments lab.**

1. Measurement of angle with the help of sine bar/ Vernier Bevel protractor.
2. Study and sketch of various types of optical projectors.
3. Study and sketch of various types of comparators and use them for comparing length of given piece.
4. To measure the diameter of a hole with the help of precision balls.
5. To measure external and internal taper with the help of taper gauges, precision rollers.
6. To test the squareness of a component with auto-collimeter.
7. To measure the pitch, angle and form of thread of a screw.
8. To measure the geometry of a gear having involute profile.
9. To measure the straightness of the edge of a component with the help of auto-collimeter.
10. To measure the length, breadth, thickness, depth, height with micrometer.
11. To measure the length, breadth, thickness, depth, height, with height gauge and Vernier calipers.
12. Calibration of Vernier calipers/micrometers.
13. Calibration of height gauge/depth gauge.
14. Study of a tool maker's microscope.
15. Checking of accuracy of snap gauge with slop gauge.
16. Checking of accuracy of a plug gauge with micrometer.
17. Measurement of areas by polar planimeter.
18. Use of feeler, wire, radius and fillet gauges measurement of standard parameters

### **Heat Transfer Lab.**

#### **Experiments on Conduction**

1. Determination of Thermal conductivity of insulation powder
2. Determination of overall heat transfer coefficient of Composite Wall
3. Determination of overall heat transfer coefficient of Lagged Pipe
4. Determination of Thermal Conductivity of given Metal Rod

#### **Experiments on Convection**

5. Determination of heat transfer coefficient of Pin-Fin (Natural and Forced Convection)
6. Determination of heat transfer coefficient of Natural Convection
7. Determination of heat transfer coefficient of Forced Convection.

#### **Experiments on Radiation**

8. Determination of Stefan Boltzman Constant
9. Determination of Emissivity of test plate

#### **Experiments on Applications of heat transfer and heat transfer with phase change**

10. Determination of effectiveness and overall heat transfer coefficient using Parallel and Counter flow Heat Exchanger
11. Determination of heat transfer coefficient in drop and film wise condensation
12. Determination of Critical Heat flux
13. Study of heat pipe and its demonstration

**Level 5 (Semester II)**  
**Industrial Management**

**Unit -1. Introduction:**

Growth of industry, The management of men, materials and machines, the art of management, Sources of capital- industrial individual enterprise, private partnership and private Ltd. Co., Joint Stock Co. shares, debentures, financial agencies and their role in promoting industries. Break even analysis.

**Unit-2. Private sector and public sector:**

Public sector enterprise, merits and demerits of public sector industry and private sector industry, Line, staff and functional organizations, reasons for the choice of various types of organization, functions of different departments, viz. stores, purchase and sales departments relationship between individual departments.

**Unit-3. Wages & incentives:**

Definition of wages, real wage and nominal wage, systems of wage payment, incentives, financial and non - financial incentives, Essentials of a good wage plan, essentials of a good incentive scheme. Introduction to elements of cost & indirect expenses, Material cost, labour cost, fixed and variable overheads, components of cost, selling price, Factory expenses, administrative expenses, selling & distribution expenses, depreciation, obsolescence, interest on capital, Idleness, Repair and maintenance.

**Unit-4. Labour, industrial & tax laws:**

Evolution of industrial law, factory act, workmen compensation act, payment of wages act, employee's state insurance act, Industrial dispute act. Role of technician in industry: Position of technician in various engineering departments, Role of a supervisor in industry, Foremanship, duties and qualities of a good foreman.

**Unit-5. Material management:**

Introduction, Scope of Material Management selective control techniques-ABC analysis, Material handling, inventory control, Essential steps in inventory control, quality standards



## **Total Quality Management**

### **Unit-1. Introduction, Basic concepts**

#### **of total quality management**

Introduction to Quality, Dimensions of Quality, Quality Planning, Concept and definition of quality cost, Determinants of Quality, Optimum cost of performance, Principles of TQM, Pillars of TQM, Introduction to leadership and Leadership roles, Quality council and Quality statement, Strategic Planning Process, Deming philosophy

#### **Unit-2. Continuous process improvement**

Input /output process Model, Juran trilogy, PDCA Cycle, 5 –‘S’ Housekeeping principle, Kaizen Seven tools of Quality (Q-7 tools), Check Sheet, Histogram, Cause and effect diagram, Pereto diagram, Stratification analysis, Scatter diagram, Control charts, Control chart for variables & process capability, Control chart for attributes

### **Unit-3. Management planning tools & Bench marking**

Affinity diagram, Relationship diagram, Tree diagram, Matrix diagram, Matrix data analysis, Arrow Diagram, Process decision programme chart (PDPC), Concept of bench marking, Reason to bench marking, Bench marking process, Types of bench marking, Benefits of bench marking

### **Unit-4. Just in time (JIT)**

JIT philosophy, Three elements of JIT, Principles of JIT Manufacturing, JIT Manufacturing building blocks, JIT benefits, Kanban & 2 Bin Systems

### **Unit-5. Total productive maintenance (TPM)**

Concept of Total Productive Maintenance, Types of maintenance, OEE (Overall Equipment Efficiency), Stages in TPM implementation, Pillars of TPM, Difficulties faced in TPM implementation.

## **Entrepreneurship**

### **Unit 1. Entrepreneurship**

#### **and entrepreneur:**

Need of Employment and Opportunities, Essential Characteristics of a good Entrepreneur, Industrial Policy, Classification of industries- Micro, small scale, Medium scale, Large scale, Type of industries- Production, Job based & Service

#### **Unit 2. Entrepreneurial Development:**

Product identification/ selection, Site selection, Plant layout, Institutional support needed, Pre-market survey.

#### **Unit 3. Entrepreneurship Support System and Start-ups:**

Introduction to start-up's, Role of District Industries Centre in setting up industry, Function of NSIC, SISI, NISIET, NRDC, SSIC, SIDO, NMTC, KVIC, RSMML, Role of state finance corporation, state electricity corporations, pollution control board, BIS, I.S.O. etc.

#### **Unit 4. Introduction to Tax System, Insurance and Acts:**

Idea of income tax, sales tax, excise duty and custom duty, Industrial and fire insurance, procedure for industrial insurance, Introduction to Industrial acts, factory act, Workmen's compensation act 1923, Apprentices act 1961, Environmental protection act 1986.

#### **Unit 5. Project Report Preparation:**

Procedure of preparing a project report, Format of project report, Preparation of project report, Introduction to ISO: 9000 Series of Quality System

## Refrigeration & Air Conditioning Applications

### Unit I: Food Preservation

Introduction, factors contributing to food spoilage, causes of food spoilage, methods of food preservation, freezing method of food preservation, preservation of food with direct contact of liquid N<sub>2</sub>, freeze drying, preservation of different products, cold storage and commercial cabinets.

### Unit II: Commercial Applications

Introduction, air-conditioning of houses, offices, hotels and restaurants, air-conditioning of departmental stores, air-conditioning of theatres and auditoriums, hospitals and medical applications

### Unit III: Ice-Manufacturing

Introduction, principles of ice production, different methods of ice manufacturing, treatment of water for making ice, brines, freezing tanks, ice cans, quality of ice

### Unit IV: Industrial Applications

Introduction, importance of RH in different industries, ice-cream manufacturing, refrigeration for breweries, selection of refrigerant for breweries, use of liquid N<sub>2</sub> for fabric, quality, air conditioning in textile and photographic industries

### Unit V: Transport Air Conditioning

Introduction, automobile air conditioning, railway air-conditioning, marine air conditioning, aircraft air conditioning

### Recommended books:

1. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
2. course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi

### Reference books:

1. Refrigeration and Air Conditioning by C.P.Arora, McGraw Hill education (India) (P) limited, New Delhi
2. Principles of Refrigeration by Roy J. Dossat, Pearson education, New Delhi

### Project -1

On the basis of learning and skill acquired in the academic year, a project to be taken up by the student strengthening his/ her vocational skills

## Basic Electrical and Electronics Lab

### Basic Electrical – Practicals

Verify that resistance of conductor is directly proportional to resistivity and length and inversely proportional to cross-sectional area of the conductor.

2. Verification of Ohm's Law.
3. Verification of temperature coefficient of resistance:
  - (i) Positive for Tungsten and Nichrome and
  - (ii) Negative for carbon.
4. Study of series resistive circuits.
5. Study of parallel resistive circuits.
6. Study of series and parallel connection of cells in circuits.
7. Preparation of Electrolyte for lead acid battery and its charging and measurement of Specific gravity with the help of hydrometer.
8. To find heat efficiency of an electric kettle.
9. Charging and Discharging of a capacitor.
10. Verification of magnetic field of a Solenoid with:
  - (i) Iron core and
  - (ii) Air core.
11. Verification of Faraday's Laws of electromagnetic induction.
12. Verification of Torque development in a current carrying coil in magnetic field.
13. Study of R.L. series circuit and measurement of power and power factor.
14. Study of R.C. series circuit and measurement of power and power factor.
15. Study of R.L.C. series circuit and measurement of power and power factor.
16. Study of R.L.C. series circuit for calculation of inductive reactance, capacitive reactance, impedance and Q-Factor.

### Basic Electronics – Practicals

1. Study of current and voltage measurement using Ammeter and Voltmeter.
2. Study of current and voltage measurement using Galvanometer.
3. Study of current, voltage and resistance measurement using of Multi-meter
4. Study of Power and Energy measurement using Wattmeter and Energy meter.
5. Study of working principle of Signal Generator and measurement of amplitude, time period and frequency of signal using Oscilloscope.
6. Study of V-I Characteristic of Diode.
7. Study of V-I Characteristic of Zener Diode. And use of Zener Diode as voltage regulator.
8. Study of Half wave rectifier with and without filter circuit.
9. Study of Full wave rectifier with and without filter circuit.
10. Study CE configuration for NPN and PNP transistors and measurement of voltage and current gain.
11. Study CB configuration for NPN and PNP transistors and measurement of voltage and current gain.
12. Study CC configuration for NPN and PNP transistors and measurement of voltage and current gain.
13. Study of working of single layer PCB manufacturing
14. Study of working of double layer PCB manufacturing.
15. Design of 7 segment display using LED and bread board.

**Instruments Required (Electrical)**

- Trainer kit for verifying ohm's law,
- Trainer kit for measuring TCR
- Lead acid battery,
- Hydrometer,
- Electric kettle
- Trainer kit for measuring power and power factor in RLC circuits

**Instruments Required (Electronics)**

- Ammeter
- Voltmeter,
- Multi-meter,
- Galvanometer,
- Energy Meter,
- CRO,
- Diode Trainer kit
- Zener diode Trainer kit
- Rectifier trainer kit
- Transistor characteristics trainer kit,
- PCB manufacturing Lab
- Bread board trainer kit to design 7 segment displays.

## Level 6 (Semester III)

### RAC Piping Systems – I

#### Bridge Course

Basic understanding Engineering Drawing

#### Unit I

Codes, Standards and Specifications: Piping codes, ASME codes and standards, ASTM Specifications,

#### Unit II

ASME Boiler, Pressure vessel codes, ASME B31-Code for pressure piping, mechanical strength, testing of piping system and valves, fabrications.

#### Unit III

Piping Components: Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material, specifications, pipe ends, pipe fittings, pipe support,

#### Unit IV

valves—gate valve, globe valve, check valve, ball valve, plug valve, butterfly valve, control valve, pressure relief valve, valve, codes and standard, valve size, pressure class rating.

#### Unit V

Viscosity, Reynolds number, friction factor, Darcy Weisback friction factor, friction factor for laminar and turbulent flows, equivalent pipe length, hydraulic radius, compressible, flow,

#### Recommended Books

1. Piping and Pipeline Calculations Manual by J. Phillip Ellenberger
2. The fundamentals of piping design by Peter Smith.

#### Reference Books:

1. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw-hill international edition, Singapore.
2. ASHRAE handbook, 2002

## Refrigeration & Air-conditioning Material – I

### Unit I

Introduction, desired properties of ideal insulating material, factors effecting the thermal conductivity,

### Unit II

types of insulating material., reflective insulating blinds, laprock – a thermal acoustic and fire insulation, natural insulator, new transparent heat insulator, heat transfer through insulation used for A.C,

### Unit III

thickness of insulation, few insulated systems, low temperature insulations, importance of relative humidity for the selection of the insulations, air distribution for reducing heat lose.

### Unit IV

Cables and Wiring: Cryocables, economics of cryocables, A.C. super conducting cables, liquid N<sub>2</sub> cooled cables, Liquid H<sub>2</sub> cooled cables, super magnet, electric generator, minimal insulated cables, installing cables

### Unit V

Component Material: Refrigeration component material, duct material, material used in evaporator, material used in compressor, material used in condenser.

## Refrigerants

### Unit I

Introduction: Refrigerants, cooling media and liquid absorbents, azeotropic and zeotropic, numbering of refrigerants.

### Unit II

Classification and Properties of Refrigerants: Requirement for refrigerant, classification-based on working principle, safety and chemical composition, desirable properties of refrigerants-thermodynamic properties, safe working properties, physical properties etc

### Unit III

Choice of Refrigerant: Important refrigerants, secondary refrigerant, anti-freeze solution, selection of refrigerant for required purpose,

### Unit IV

Application of Refrigerants: refrigerant oils and applications, Properties and uses of commonly used refrigerant

### Unit V

Greenhouse effect, Global warming, Future Refrigerants like Hydrofluoro-Olefines

### Recommended books

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi

### Reference books

1. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw-hill international edition, Singapore
2. Refrigeration and Air Conditioning by P.L.Ballaney, Khanna publishers, New Delhi

Modern Refrigeration and Air Conditioning by Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, The goodheart-willcox company, INC



## RAC Standards

### Unit I

Introduction: Meaning of IS, need of IS, international classification of standards for refrigeration and air conditioning, various national and international standards for heating, ventilation and air conditioning

### Unit II

Procedure of standard development, levels of standard, main standardization, organizations, i.e. ISO-international organization for standardization, IEC-international electro technical commission and others international and national organizations

### Unit III

Existing Standards: Main technical standards relevant to HCFC phase-out and low GWP (Global Warming Potential) alternatives, ISO, IEC, ECS (European Committee for Electrical Technical Standardization)

### Unit IV

Adoption of International Standards at National Level: National standardization bodies, national ozone units, accreditation bodies, national RAC associations, the process of adoption

### Unit V

Use of International Standards: In designing of refrigeration and air conditioning equipment, selection of materials related to refrigeration and air conditioning, safety issues related to refrigeration and air conditioning, industrial and field applications.

### Recommended books

1. International Standards in Refrigeration and Air Conditioning , UNEP (United Nations Environment Program)
2. Refrigeration and Air Conditioning data book, New Age International Publication

### Reference books

1. ISHRAE standard book for Refrigeration and Air Conditioning
2. ASHRE hand book for Refrigeration and Air Conditioning

### **RAC Materials Lab**

Any eight of the following practical should be performed and recorded in laboratory book

1. Identification of types of copper tubes (dia. 3 mm, 6 mm, 12.5mm)
2. Identification of types of brazing rod and its composition
3. Identification of oil and grease removals, fire hazard of the removals
4. Familiarization of joining material, gasket, pipe joint
5. Introduction of various insulating material, properties, fire hazard, etc.
6. Soldering and Brazing – types of brazing, preparation, purging. applying flux, applying heat.
7. Pipe Bending – Introduction to tools and different bends, pipe cutting.
8. Electrical requirement – introduction and familiarization with electrical symbols, circuit diagram of the RAC system
9. Introduction to gas welding set, simple gas welding, arc welding
10. Identification and testing of resistor, diodes and transistors
11. Identification of refrigerant cylinder by color coding and standing pressure – types of cylinder
12. Technique of glass wool filling method in conventional refrigerant.

### **RAC Systems Installation & Maintenance Lab. – I**

1. Handling, use and familiarization with refrigeration tools and accessories such as: (a) Tube cutter (b) Tube bender [spring type] (c) Flaring tool (d) Swaging tool (e) Pinch off tools (f) Service valve wrench (g) Service valve (h) Adjustable wrench (i) Spanner set (j) Allen Key (k) Gauges (l) Blow lamp (m) Service cylinder (n) Gauge manifold (o) Wheel puller (p) Vacuum pump (q) Halide torch (r) Practicing of related operations.
2. Study of the following units: (a) Domestic refrigerator (b) Water cooler (c) Room Air conditioner (d) Evaporative cooler (e) Experimental ice plant.
3. Experimental ice plant.
4. Study of the following components and controls: (a) Compressor: open type and sealed types (b) Thermostatic expansion valve (c) Surface condenser (d) Different types of evaporators (e) Solenoid valve (f) Thermostat for refrigeration (g) H.P. and L.P. cut out (h) Gil safety switch (i) Strainers and driers.

**Level 6 (Semester4)**  
**RAC Piping Systems – II**

**Unit I**

Pipe Size Calculations: Pipe sizing, pipe sizing formulae, pipeline wall thickness calculation, elements of total dynamic head–static head, pressure head, velocity head, friction head, Pump power required, Cavitations in pumps, NPSH required and NPSH available for pumps.

**Unit II**

Pipe Stress Analysis: Objectives and definition of stress analysis, piping loads, piping stresses-primary, secondary, pipe span, calculations flexibility analysis–expansion loops and expansion joints, concept of thermal expansion, providing flexibility in piping

**Unit III**

Assembly and Erection: Fabrications materials for piping systems, fabrication drawings, fabrication processes, Assembly-alignment, flanged joints, threaded joints,

**Unit IV**

Piping System Testing: Examinations methods, visual examination, magnetic particle examination, Liquid penetrant examination, radiographic examination, ultrasonic examinations,

**Unit V**

Testing–leak, test, preparation for leak test, hydrostatic leak test, pneumatic leak test, sensitive leak test, examination of welds

**Recommended Books**

3. Piping and Pipeline Calculations Manual by J. Phillip Ellenberger
4. The fundamentals of piping design by Peter Smith.

**Reference books:**

2. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw-hill international edition, Singapore.
3. ASHRAE handbook, 2002

## Refrigeration & Air-conditioning Material – II

### Unit I

Component Material: Material used in expansion valve, different type of valve material

### Unit II

Material used in cooling towers, pipeline materials, drying materials, jointing, material, synthetic repair materials.

### Unit III

Oils and Lubrication: Need of lubrication, types of lubrication, properties of lubrication oils, lubrication systems

### Unit IV

Selection of refrigerant lubricant, compatibility of lubricant with refrigerant fluidrefrigeration oil with additives, the effect of refrigerant on lubricant density, solvent and cleaning.

### Unit V

Tubing: Soft copper tubing, hard-drawn copper tubing, steel tubing, normal size copper tubing, Cutting tubing, bonding tubing, connecting tubing, flaring tubing.

### Recommended books

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi

### Reference books

1. Modern Refrigeration and Air Conditioning by Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, The goodheart-willcox company, INC

## RAC Maintenance – I

### Unit I

RAC Tools: Engineering hand tools: spanners, screwdrivers, pliers, hammers, brazing, welding, flaring tool, tube bender, hammer, wrenches, shock wrenches, files, hacksaws, wood saws, electrical hand drill, sheet metal snips, Allen keys pop riveter, chisels, pulley extractors, Center punch, wire brush, drill bits, oil can, knife, inspection lamp, bolt extractor

### Unit II

Measuring equipment's- steel tape measure, feeler gauge, Caliper, micrometer, engineers levels, pocket type of thermometer, sling psychomotor, system analyzers, temperature analyzers, electronic leak detector, voltmeter, clamp-on ammeter

### Unit III

Specialist tools and accessories: flexible charging line, bending springs, pipe tube cutter, fin combs, soldering and brazing equipments, Vacuum pump, charging cylinders, electric test lamps, jumper lead, welding goggles

### Unit IV

Pipe installation work, pumping down the system, purging the system, starting the plant

### Unit V

Using a system analyzer, transferring and handling liquid refrigerant

### Recommended books

1. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpatrai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
3. Electric controls for Refrigeration and Air Conditioning by B.C. Langley, D.B. Taraporevala sons and co. pvt.ltd., Bombay

### Reference books

1. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw-hill international edition, Singapore
2. Refrigeration and Air Conditioning by P.L.Ballaney, Khanna publishers, New Delhi
3. Modern Refrigeration and Air Conditioning by Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, The goodheart-willcox company, INC
4. Refrigeration and Air Conditioning Technology by William C. Whitman, William M. Johnson and John A. Tomczyk, Delmar Thomson learning, USA

## **RAC Installation Techniques - I**

### **Unit I**

Introduction: Installation operation, adding oil, testing for leak detection

### **Unit II**

Evacuation and dehydration, removing air, charging of the system, through suction valve, through discharge valve.

### **Unit III**

Installation of Room Air-Conditioner: Selection of proper location, providing proper slope and provision for to drain water

### **Unit IV**

Ventilation arrangement for window air conditioner, wiring diagram for installation for room air, conditioner

### **Unit V**

Installation of split air conditioner, providing arrangement for pipes and pipe, pipe insulations

### **Recommended books**

1. Air conditioning: procedures and installation by V. Paul Lang, CBS publishers & distributors, Delhi
2. Refrigeration Technicians pocket book by F.H. Meredith, Butterworths

## **(6.VP.03) RAC System Installation & Maintenance Lab. – II**

1. Leak detection in refrigeration system by different methods.
2. Air removal and charging of a refrigeration unit.
3. Testing of a refrigeration system to find out: (a) Refrigerating capacity (b) Power input  
c) C.O.P.
4. Determination of psychrometric properties of air with the help of a sling psychrometer and aspiration psychrometer.
5. Determination of by pass factor of a cooling coil.
6. Determination of humidifying efficiency of an evaporative cooler.
7. Determination of cooling load for a specified situation.
8. Study of the following system by visit: (a) Ice Plant (b) Cold storage plant (c) Control air conditioning system.

### **SUGGESTED READING:**

REFRIGERATION AND AIR CONDITIONING: A Sarao  
REFRIGERATION AND AIR  
CONDITIONING: RS Khurmi

## RAC Piping Systems Lab.

### List of Experiments

**Any six of the following practical should be performed and recorded in laboratory book:**

1. Study of piping codes, ASME codes and standards, ASTM Specifications
2. Study of Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material specifications, pipe ends
3. Study of pipe fittings—elbows, tees, flanges, butt welded end fittings, socket welded and threaded end fittings
4. valves—gate valve, globe valve, check valve, ball valve, plug valve, butterfly valve, control valve, pressure relief valve, valve codes and standard, valve size, pressure class rating.
5. Study of pipeline wall thickness calculation
6. Study of NPSH required and NPSH available for pumps
7. Study of piping load and piping stresses
8. Study of different leak detection methods
9. Checking the performance of air ducting system

## Level 7 (Semester 5)

### RAC Maintenance - II

#### Unit I

Checking the charge, electrical circuits (servicing), evacuation of the system, installation, and location of main components, leak detection methods

#### Unit II

Servicing Techniques: Piping and Joining Work, Burn out repair, capillary tube cleaning

#### Unit III

Charging the system, compressor work expansion valve (thermostatic), servicing, hermetic compressor motors (stating problems) repairing leaks, sealed system connections.

#### Unit IV

Electrical Fault Finding: Compressor motor fails to start, compressor motors tries to start but does not run, compressor motor starts but does not reach running speed, thermostat failure type, pressure cut-out failure, wiring and collection faults

#### Unit V

Mechanical Fault Finding: Fault analysis by temperature and pressure, methods of confirming the fault, finding the fault when the compressor is not running, abnormal noise problem, domestic system faults

### RAC Installation Techniques – II

#### Unit I

Commercial Installations of Refrigeration Systems: Ice manufacturing plant, ice bank

#### Unit II

Commercial Installations of Refrigeration Systems: Cold storage plant, milk dairy plant

#### Unit III

Commercial Installation of Air Conditioning Systems: Office air conditioning, Hotel air conditioning

#### Unit IV

Central air conditioning, Designs, Factors of consideration for Central AC

#### Unit V

Automobile air conditioning: Need, Types, Selection of AC System, Ducts



## **Automobile Air Conditioning**

### **Unit I**

Introduction: Methods of refrigeration. Vapour compression refrigeration system, vapour absorption refrigeration system, applications of refrigeration & air conditioning, Automobile air conditioning, air conditioning for passengers, isolated vehicles, Refrigerated transport vehicles, applications related with very low temperatures, Study of Psychometric charts: Psychometric properties, tables/charts, psychometric processes, comfort charts, factors affecting comfort, effective temperature, ventilation requirements.

### **Unit II**

Refrigerants & AC Systems: Importance of Refrigerant- Classification, properties, selection criteria, commonly used refrigerants, alternative refrigerants, eco-friendly refrigerants; applications of refrigerants, refrigerants used in automobile air conditioning, Air Conditioning Systems- Classification, layouts, central / unitary air conditioning systems, System components, Switch and electrical wiring circuit.

### **Unit III**

Design Automobile AC system: Load Calculations & Analysis- Design considerations for achieving desired inside/room conditions with respect to prevailing outside/environment conditions. Factors affecting/contributing towards the load on refrigeration & air conditioning systems, Cooling& heating load calculations, Load calculations for automobiles, Effect of air conditioning load on engine

### **Unit IV**

Air Distribution: Air Distribution Systems- Distribution ducting, sizing, supply / return ducts, type of grills, diffusers, ventilation, air noise level, layout of duct systems for automobiles and their impact on load calculations

Electronic control : Air Routing & Temperature Control - Objectives of the dashboard re-circulating unit, automatic temperature control, controlling flow, control of air handling systems & air flow through - evaporator care

### **UNIT V**

AC Service & Control: Air Conditioning Service- Air conditioner maintenance & service - removing & replacing Components. Compressor service, Testing, Diagnosis & trouble shooting of air conditioning system, Refrigerant gas charging procedure &. Servicing of heater system, Air Conditioning Control - Common controls such as thermostats, humidistat, control dampers, pressure cut outs, relays.

### **Non-conventional Refrigerating System**

1. Vapour Absorption Refrigeration System: Principle of absorption system, comparison between vapour compression system and vapor absorption system, theory of binary mixtures,
2. Aqua-ammonia vapour absorption system, theory of mixtures, temperature concentration diagram and enthalpy concentration diagram, processes used in aqua-ammonia absorption system, adiabatic mixing, separation, throttling process,
3. Vapour absorption system its components, working principle and mathematical analysis, b. Lithium-bromide- water absorption system its components, working principle, and mathematical analysis
4. Steam Jet Refrigeration System: Introduction, steam jet refrigeration system, components of steam jet refrigeration system, advantage and limitation of steam jet refrigeration system, performance of steam jet refrigeration system
5. Thermo-Electric Refrigeration System: Introduction, thermo-electric effects, Seebeck effect, Peltier effect, Thomson effect

### **Recommended books**

1. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpatrai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi

### **Automobile AC Lab.**

1. To study the load requirement of AC in the vehicle.
2. To design the AC System for the automobile according to the use.
3. To select the components for Automobile AC System
4. To install the AC System in automobile
5. To diagnose the fault in Automobile AC System
6. To conduct the mechanical repair in the Automobile AC System
7. To charge the Refrigerant in the Automobile AC System
8. To test the Automobile AC System.

### **AC Components and Assembly Laboratory**

Any five of the following practical should be performed and recorded in laboratory book

1. To study hermetically sealed compressor, condensing units, performance, volumetric efficiency, performance of the ideal compressor and power requirement
2. To study different types of condensers and condenser design
3. To study different types of evaporators and evaporator performance, pressure drop in tubes, frost.
4. To study selection of expansion valves, and capillaries for various refrigeration and airconditioning applications
5. Find out the heat rejection factor of condenser, condenser capacity, efficiency and effect of fouling factor
6. Capillary bore checking, performance test conducted by test rig (consisting of capillary tube and thermostatic expansion valve) for finding C.O.P.
7. Familiarization of capillary selection guide

## Level 7 (Semester 6)

### RAC Safety

#### Unit I

Introduction to Industrial Safety: History and development of safety movement, need for safety, safety legislation: acts and rules, safety standards and codes, safety policy: safety organization and responsibilities and authorities of different levels, accident sequence theory, causes of accidents, accident prevention and control techniques, plant safety inspections, job safety analysis and investigation of accidents, first aid.

#### Unit II

Overview of Standard: ANSI/ASHRAE Standard, ANSI/ASME boiler and pressure vessel code, refrigeration, piping code, boiler and pressure vessel code, safety for refrigerant-containing components and accessories, nonelectrical, uniform mechanical code, basic national mechanical code

#### Unit III

Safety on the Job: Personal safety, protective clothing and equipment, harmful substances, safe work, practices, safety when working with electricity, refrigeration safety.

#### Unit IV

Safety for RAC Engineers: Types of accident, physical injuries from mechanical causes, use of tools and handling precautions, electrical injuries, electrical safety rules

#### Unit V

Injuries in RAC and Precaution: Refrigerant cylinder, corrosion, burn and other scalds, refrigerants and other gases Construction materials, fire fighting precautions, breathing, toxic gases, asphyxiation and precaution for the same.

#### Recommended books

1. "Air conditioning Systems principles, equipments and Services", Joseph Moravek, Prentice Hall

#### Reference books

1. "HVAC Handbook", Part I and II, ISHRAE
2. "Industrial refrigeration Hand Book", Wilbert F. Stoecker

### Process Planning and Cost Estimation

#### 1. Introduction to Process Planning:

Process Planning—Definition, Purpose of Process Planning, Concept of Process Planning, Objectives of Process Planning, Scope of Process Planning, and Information required to do Process Planning, Preparing Operation Planning Sheet

#### 2. Process Planning activities:

Process Planning Procedure, Approaches of Process Planning, Manual Process Planning, Computer Aided Process Planning, Factors Affecting Selection Process, Machine Capacity, Determination of Man, Machine and Material Requirements, Factors Influencing Choice of Machinery

**3. Introduction to Cost Estimation:**

Reasons for doing Estimates, Importance of Estimating, Objectives or Purpose of Estimating, Functions of Estimating, Cost Accounting of Costing, Importance of Costing, Aims of Cost Accounting, Difference Between Cost Estimating and Cost Accounting, Cost of Product (Ladder of Cost) Production Cost Estimation, Determination of Material Cost, Mensuration in Estimating

**4. Assembly & Installation Time Calculation:**

Time calculation: Study of RAC requirement, design of RAC System, Selection of RAC components & material, Fabrication of ducts and distribution system, installation of RAC System, Testing of RAC System.

**Project**

On the basis of learning in the B.Voc. Programme, i.e. Level 5 to Level 7, a project to be taken up by the student strengthening his/ her vocational skills

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc.  
Software Development (SD)  
Branch Code:106**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

**EVALUATION SCHEME**  
**Software Development**

NSFQ Level 5 SEMESTER- I											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BSDV511	IT Foundations & Programming Concepts	30	10	5	5	20	30		50	2
2	BSDV512	Web Designing	30	10	5	5	20	30		50	2
3	BSDV513	Programming in C	30	10	5	5	20	30		50	2
4	BSDV514	Operating System (OS)	30	10	5	5	20	30		50	2
6	BSDP511	Web Designing Lab	30				20		30	50	1
7	BSDP512	C Programming Lab	30				20		30	50	1
8	BSDP513	Language Lab	30				20		30	50	2
9	BSDT511	Technical Writer (SSC/Q0505)						Any one Training 400 hrs / 8 weeks	150	12	
	BSDT512	Infrastructure Engineer (SSC/Q0801)									
	BSDT513	Associate – CRM (SSC/Q2202)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 5 SEMESTER- II											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BSDV521	Data Structures	30	10	5	5	20	30		50	2
2	BSDV522	Concepts of Data Mining	30	10	5	5	20	30		50	2
3	BSDV523	OOPs with Java	30	10	5	5	20	30		50	2
4	BSDV524	Multimedia Tools & Applications	30	10	5	5	20	30		50	2
6	BSDP521	Data Structure Lab	30				20		30	50	1
7	BSDP522	Java Lab	30				20		30	50	1
8	BSDP523	IT Tool Lab	30				20		30	50	2
9	BSDT521	Web Developer (SSC/Q0503)						Any one Training 400 hrs / 8 weeks	150	12	
	BSDT522	Test Engineer (SSC/Q1301)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 6 SEMESTER- III											
S. No.	Subject Code	Subject	Total Teaching / Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BSDV631	Linux Operating System – Operations and Management	30	10	5	5	20	30		50	2
2	BSDV632	Software Engineering	30	10	5	5	20	30		50	2
3	BSDV633	Web Development using PHP	30	10	5	5	20	30		50	2
4	BSDV634	Windows Development Fundamental	30	10	5	5	20	30		50	2
5	BKVE631	Uni. Human Values & Ethics	30	10	5	5	20	30		50	2
6	BSDP631	Web Development using PHP Lab	30				20		30	50	1
7	BSDP632	Window Development Fundamentals Lab	30				20		30	50	1
8	BSDT631	Junior Data Associate (SSC/Q0401)						Any one Training 400 hrs/ 6 weeks	150	12	
	BSDT632	IP Executive (SSC/Q6201)									
	BSDT633	Security Analyst (SSC/Q0901)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 6 SEMESTER- IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BSDV641	Software Testing and Project Management	30	10	5	5	20	30		50	2
2	BSDV642	Android Application Development	30	10	5	5	20	30		50	2
3	BSDV643	Window Configuration and Server Administration	30	10	5	5	20	30		50	2
4	BSDV644	Management Information Systems	30	10	5	5	20	30		50	2
5	BKVE641	Environment and Ecology	30	10	5	5	20	30		50	2
6	BSDP641	Android Application Development Lab	30				20		30	50	1
7	BSDP642	MIS Lab	30				20		30	50	1
8	BSDT641	QA Engineer (SSC/Q1302)						Any one Training 400 hrs/ 8 weeks	150	12	
	BSDT642	Software Engineer (SSC/Q4601)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BSDV751	Technology Trends in IT	30	10	5	5	20	30		50	2
2	BSDV752	Window Mobile Application Development	30	10	5	5	20	30		50	2
3	BSDV753	Introduction to Python Programming	30	10	5	5	20	30		50	2
4	BSDV754	Introduction to Microprocessors	30	10	5	5	20	30		50	2
5	BKVH751	Constitution of India, Law and Engineering	30	10	5	5	20	30		50	2
6	BSDP751	Window Mobile Application Development Lab	30				20		30	50	1
7	BSDP752	Python Programming Lab	30				20		30	50	1
9	BSDT751	Management Trainee (SSC/Q6301)						Any one Training 400 hrs/ 6 weeks	150	12	
	BSDT752	Associate - Transactional F&A (SSC/Q2301)									
	BSDT753	Consultant Network Security (SSC/Q0917)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BSDV761	Introduction to AI/ Computer Network Security	30	10	5	5	20	30		50	2
2	BSDV762	e-Commerce / Introduction to Biometrics	30	10	5	5	20	30		50	2
3	BKVH761	Indian Tradition, Culture and Society	30	10	5	5	20	30		50	2
4	BSDP761	Major Project based on AI or Computer Network Security	180						150	150	6
5	BSDT761	Master Trainer for Software Developer (SSC/Q0509)						Any one Training 400 hrs/ 6 weeks	200	12	
	BSDT762	Hardware Engineer (SSC/Q4701)									
<b>Total</b>			<b>670</b>							<b>500</b>	<b>24</b>



## Detailed Curriculum

### Software Requirements

1. C Compiler(Turbo C/C++ etc)
2. WYSIWYG HTML editor (Eclipse, Netbeans etc)
3. Python
4. JDK
5. Apache Tomcat
6. PHP,WAMP/XAMPP
7. DBMS(ORACLE, MySQL etc)
8. .Net Framework
9. Android Studio

### Level 5 (Semester I)

#### IT Foundations & Programming Concepts

**Computer characteristics:** Speed, storage, accuracy, diligence; Digital signals, BinarySystem, ASCII; Historic Evolution of Computers; Classification of computers: Microcomputer, Minicomputer, mainframes, Supercomputers; Personal computers: Desktop, Laptops, Palmtop, Tablet; Hardware & Software; Von Neumann model.

**Hardware:** CPU, Memory, Input devices, output devices. Memory units: RAM (SDRAM, DDR

RAM, RDRAM etc. feature wise comparison only); ROM-different types: Flash memory; Auxiliary storage: Magnetic devices, Optical Devices; Floppy, Hard disk, Memory stick, CD, DVD, CD/DVD-Writer; Input devices - keyboard, mouse, scanner, speech input devices, digital camera, Touch screen Voice Input, Joystick, Optical readers, bar code reader; Output devices: Display device, size and resolution; CRT, LCD, LED; Printers: Dot-matrix, Inkjet, Laser; Plotters, Sound cards & speaker.

**Software:** System software, Application software; concepts of files and folders,Introduction to Operating systems, Different types of operating systems: single user, multitasking, time-sharing multi-user; Booting, POST; Basic features of two GUI operating systems: Windows & Linux (Basic desk top management); Programming Languages, Compiler, Interpreter, Databases; Application software: Generic Features of Word processors, Spread sheets and Presentation software; Generic Introduction to Latex for scientific typesetting; Utilities and their use; Computer Viruses & Protection, Free software, open source.

**Computer Networks and Internet:** Connecting computers, Requirements for a network:Server, Workstation, switch, router, network operating systems; Internet: brief history, World Wide Web, Websites, URL, browsers, search engines, search tips; Internet connections: ISP, Dial-up, cable modem, WLL, DSL, leased line Wireless and Wi-Fi connectivity ; email, email software features (send receive, filter, attach, forward, copy, blind copy); characteristics of web-based systems, Web pages, Web Programming Languages.

**Information Technology And Society:** Indian IT Act, Intellectual Property Rights, issues. Application of information Technology in Railways, Airlines, Banking, Insurance, Inventory Control, Financial systems, Hotel management, Education, Video games, Telephone exchanges, Mobile phones, Information kiosks, special effects in Movies.

**Programming Concepts & Techniques:** Program Concept, Characteristics of Programme, Stages in Program Development, Tips for Program Designing, Programming Aids, Algorithms, Pseudo code, Notations, Design, Flowcharts, Symbols, Rules, compiler & Interpreter. Introduction to programming techniques, Top-down & Bottom-up approach, Unstructured, & Modular programming, Cohesion, Coupling, Debugging, Syntax & Logical Errors, Linking and Loading, Testing and Debugging, Documentation.

**Reference Books:**

1. Programming in C, R.S. Salaria, Khanna Publishing House
2. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
3. Handbook of Computer Fundamentals, N.S. Gill, Khanna Publishing House

## Web Designing

### UNIT-I

Introduction to HTTP, HTML, Basic HTML Tags, Body Tags, Coding Style, Modifying & formatting Text, Lists – Unordered, Ordered, Definition, Insert Links -Linking to another Document, Internal Links, Email Links, Relative and Absolute Links, Insert Images - Referencing Images, Clickable Images, Image Placement and Alignment, Image Size, Image Margins, Image Formats, Image Maps- Defining an Image Map, Advanced Coloring Body Content, Working with tables - Basic Tables, Table Attributes, Table Cell Attributes, Table Row Attributes, Tables Inside of Tables, Invisible Spacers, Working with Frame-Based Pages- Creating Windows, Single Window Frames, Creating Column Frames, Creating Row Frames, Creating Complex Frames.

### UNIT-II

Cascading Style Sheet (CSS) – Introduction, creating style, using inline and external CSS, Creating Divs with ID style, Creating Tag & Class style, creating borders, Navigation links, creating effects with CSS.

JavaScript – Introduction, use of JavaScript in webpages. Understand JavaScript event model, use some basic event and control webpage behavior.

### UNIT-III

DESIGNING WEBSITES WITH DREAMWEAVER/EXPRESSION Web/AMAYA/COFEE CUP WYSIWYG HTML Editor - Introduction to WYSIWYG HTML editor, advantages of using HTML editors, Creating a New Site, Creating a New Page, Adding Images with Alternate Text, Inserting & Formatting Text, Aligning Images, Creating an Email Link, Linking to Other Websites, Testing & Targeting Links, Organizing Files & Folders

CREATING & INSERTING IMAGES - Optimizing Images for the Web, Saving GIFs & PNGs in Photoshop, Inserting GIFs, Adjusting Transparency Settings, Saving JPGs for the Web

### UNIT-IV

DESIGNING ACCESSIBLE TABLES - Understanding Tables & Accessibility, Using Tables for Tabular Data, styling a Table, Editing Table Layouts, Adding Style to a Table Using CSS CREATING WEBSITES WITH FRAMES - Introducing Frames, creating a Frameset, Opening Pages into Frames, Controlling Scrollbars & Borders, Targeting Links in Frames CUSTOMIZING THE INTERFACE - Opening an Existing Site, Reviewing Menu Options & Preferences, Comparing the Macintosh & PC Interfaces, Previewing in Browsers & Device Central

Introduction to Responsive Web Designing – Introduction, advantages, creating and using responsive web pages.

### UNIT-V

Web Hosting - What is Domain? Introduction to DNS, how to register a Domain? What is web hosting? How to get a web hosting? Host your website on web Server. FTP - FTP Introduction, FTP Commands Viewing Files and Directories, FTP Commands Transfer and Rename files, FTP with WS FTP/ CuteFTP, Filezilla on Windows.

#### Reference Books:

1. Internet & Web Development, Soma Das Gupta, Khanna Publishing House
2. Web Designing and Development, TanweerAlam, Khanna Publishing House

## Programming in C

**Introduction to 'C' Language** - Character set, Variables and Identifiers, Built-in Data Types, Variable Definition, Arithmetic operators and Expressions, Constants and Literals, Simple assignment statement, Basic input/output statement, Simple 'C' programs.

**Conditional Statements and Loops** - Decision making within a program, Conditions, Relational Operators, Logical Connectives, if statement, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement, structured Programming.

**Arrays** - One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array; Finding the largest/smallest element in an array; Two dimensional arrays, Addition/Multiplication of two matrices, Transpose of a square matrix; Null terminated strings as array of characters, Standard library string functions

**Functions** - Top-down approach of problem solving, Modular programming and functions, Standard Library of C functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, Passing arguments to a Function: call by reference, call by value, Recursive Functions, arrays as function arguments.

**Storage Classes** - Scope and extent, Storage Classes in a single source file: auto, extern and static, register, Storage Classes in a multiple source files: extern and static

**Structures and Unions** - Structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions

**Pointers** - Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures, dynamic memory allocation.

**File Processing** - Concept of Files, File opening in various modes and closing of a file, reading from a file, writing onto a file

### Reference Books:

1. Programming in C, R.S. Salaria, Khanna Publishing House
2. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
3. Test your Skills in C, R. S. Salaria, Khanna Publishing House

## Operating System (OS)

**System Software:** Operating System, Compiler, Interpreter and Assembler;

**Operating System:** Need for Operating System, Functions of Operating System (Processor Management, Memory Management, File Management and Device Management), Types of Operating System-Interactive (GUI based), Time Sharing, Real Time and Distributed, commonly used Operating System: UNIX, LINUX, Windows, Solaris, BOSS (Bharat Operating System Solutions); Mobile OS – Android, Symbian, IOS.

**Utility Software:** Anti-Virus, File Management tools, Compression tools and DiskManagement tools (Disk Cleanup, Disk Defragmenter, Backup).

### Reference Books:

1. Operating Systems, EktaWalia, Khanna Publishing House

## Web Designing Lab

1. Generic awareness about Hyper Text s Language (HTML).
2. Designing of websites.
3. Basics of HTML tags.
4. Cascading Style Sheet (CSS).
5. Functional knowledge of web hosting

## C Programming Lab

1. Write a Program to find the area and circumference of circle
2. Write a Program to swap two numbers with or without third variable
3. Write a program to convert temperature from Fahrenheit to Celsius
4. write a program to add two numbers
5. Write a C program to input any alphabet and check whether it is vowel or consonant.
6. Write a C program to input any character and check whether it is alphabet, digit or special character.
7. Calculator program with Basic operations using switch
8. Program to find factorial of a given number
9. Program to find sum of Fibonacci series up to N Terms.
0. program to check whether the number is palindrome or not 1
1. Program to find the second largest number in an array.
2. Write a 'C' function to print reverse of a given number using return and parameter method.(call by value)
3. Write a 'C' function to calculate the sum of digits of a given number using return and parameter method.(call by value)
4. Program to insert element in an array.
5. Find the repeating elements in a given array
6. C program to delete duplicate element in an array. 1
7. C program to find multiplication of two matrices.
8. Program to store and access "id, name and percentage" for 3 students. Structure array is used in this program to store and display records for many students. You can store "n" number of s tudents record by declaring structure variable as 'struct student record[n]', where n can be 1000 or 5000 etc.
9. Program to copy one file into another.
0. Program to count number of alphabet, number, spaces, newline characters from a file.

## Level 5 (Semester II)

### Data Structure

#### UNIT I

An Overview of Computers and Programming - Simple program logic, The steps involved in the program development cycle, Pseudo code statements and flowchart symbols, Using a sentinel value to end a program, Programming and user environments, The evolution of programming models.

#### UNIT-II

The concept of data structure, Abstract data structure, Analysis of Algorithm, The concept of List Introduction to stack & primitive operation on stack, Stack as an abstract data type, Multiple Stack, Stacks application: Infix, post fix, Prefix and Recursion, Introduction to queues, Primitive Operations on the Queues, Queue as an abstract data type, Circular queue, Dequeue, Priority queue, Applications of queue

#### UNIT-III

Introduction to the Linked List of Stacks, Basic operations on linked list, Stacks and queues as a circular linked list, Header nodes, Doubly Linked List, Circular Linked List, Stacks & Queues as a Circular Linked List, Application of Linked List.

#### UNIT-IV

TREES - Basic Terminology, Binary Trees, Tree Representations as Array & Linked List, Basic operation on Binary tree, Traversal of binary trees: - In order, Preorder & post order, Application of Binary tree, threaded binary tree, B-tree & Height balanced tree, B+ & B\* trees, 2-3 trees, Binary tree representation of trees, Counting binary trees

#### UNIT-V

Sequential Searching, Binary search, Insertion sort, Selection sort, Quick sort, Bubble sort, Heap sort, Comparison of sorting methods

Hash Table, Collision resolution Techniques, Introduction to graphs, Definition, Terminology, Directed, Undirected & Weighted graph, Representation of graphs, Graph Traversal-Depth first & Breadth first search, Spanning Trees, minimum spanning Tree, Shortest path algorithm

#### Reference Books:

1. Data Structures, R.S. Salaria, Khanna Publishing House

## Concepts of Data Mining

### Unit-I

Introduction to Data warehousing, needs for developing data Warehouse, Data warehouse systems and its Components, Design of Data Warehouse, Dimension and Measures, Data Marts:-Dependent Data Marts, Independents Data Marts & Distributed Data Marts, Conceptual Modeling of Data Warehouses: -Star Schema, Snow flake Schema, Fact Constellations, Multidimensional Data Model & Aggregates.

### Unit-II

OLAP, Characteristics of OLAP System, Motivation for using OLAP, Multidimensional View and Data Cube, Data Cube Implementations, Data Cube Operations, Guidelines for OLAP Implementation, Difference between OLAP & OLTP, OLAP Servers: -ROLAP, MOLAP, HOLAPQueries.

### UNIT-III

Introduction to Data Mining, Knowledge Discovery, Data Mining Functionalities, Data Mining System categorization and its Issues. Data Processing:-Data Cleaning, Data Integration and Transformation. Data Reduction, Data Mining Statistics. Guidelines for Successful Data Mining.

### Unit-IV

Association Rule Mining:-Introduction, Basic, The Task and a Naïve Algorithm, Apriori Algorithms, Improving the efficiency of the Apriori Algorithm, Apriori - Tid, Direct Hasing and Pruning (DHP), Dynamic Item set Counting (DIC), Mining Frequent Patterns without Candidate Generation (FP-Growth), Performance Evaluation of Algorithms,

### Unit-V

Classification:-Introduction, Decision Tree, The Tree Induction Algorithm, Split Algorithms Based on Information Theory, Split Algorithm Based on the Gini Index, Over fitting and Pruning, Decision Trees Rules, Naïve Bayes Method.

Cluster Analysis: -Introduction, Desired Features of Cluster Analysis, Types of Cluster Analysis Methods: -Partitioned Methods, Hierarchical Methods, Density-Based Methods, Dealing with Large Databases. Quality and Validity of Cluster Analysis Methods.

### Reference Books:

1. Data Mining and Warehousing, Ikvinderpal Singh, Khanna Publishing House



## Object Oriented Programming with JAVA

### UNIT-I

C++ vs JAVA, JAVA and Internet and WWW, JAVA support systems, JAVA environment.

JAVA program structure, Tokens, Statements, JAVA virtual machine, Constant & Variables, Data Types, Declaration of Variables, Scope of Variables, Symbolic Constants, Type Casting.

Operators: Arithmetic, Relational, Logical Assignments, Increment and Decrement, Conditional, Bitwise, Special, Expressions & its evaluation.

If statement, if...else... statement, Nesting of if...else... statements, else...if Ladder, Switch, ?operators, Loops – While, Do, For, Jumps in Loops, Labelled Loops.

### UNIT-II

Defining a Class, Adding Variables and Methods, Creating Objects, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting of Methods.

Inheritance: Extending a Class, Overriding Methods, Final Variables and Methods, Final Classes, Finalize Methods, Abstract methods and Classes, Visibility Control.

### UNIT-III

Arrays: One Dimensional & two Dimensional, strings, Vectors, wrapper Classes, Defining Interface Extending Interface, Implementing Interface, Accessing Interface Variable, System Packages, Using System Package, Adding a Class to a Packages, Hiding Classes.

### UNIT-IV

Creating Threads, Extending the Threads Class, Stopping and Blocking a Thread, Life Cycle of a Thread, Using Thread Methods, Thread Exceptions, Thread Priority, Synchronization, Implementing the Runnable Interface.

### UNIT-V

Local and Remote Applets Vs Applications, Writing Applets, Applets Life Cycle, Creating an Executable Applet, Designing a Web Page, Applet Tag, Adding Applet to HTML File, Running the Applet, Passing Parameters to Applets, Aligning the Display, HTML Tags & Applets, Getting Input from the User.

### Reference Books:

1. Object Oriented Systems with Java, TanweerAlam, Khanna Publishing House
2. Core Java, TanweerAlam, Khanna Publishing House

## MULTIMEDIA – TOOLS & APPLICATIONS

### UNIT -I

Introduction To Multimedia, Needs and Areas of use, Identifying Multimedia Elements - Text, Images, Sound, Animation and Video, Making Simple Multimedia With PowerPoint. TEXT - Concepts of Plain & Formatted Text, RTF & HTML Texts, Using Common Text Preparation Tools, Conversion to and from of Various Text Formats, Creating text using standard software.

### UNIT-II

SOUND - Sound and its Attributes, Sound and Its Effects in Multimedia, Frequency, Sound Depth, Channels and its Effects on Quality and Storage, Size Estimation of Space of a Sound File, Sound Card Standard – FM Synthesis Cards, Waves Table Cards, MIDI and MP3 Files and Devices, 3D Sounds, Recording and editing sound using sound editors like Audacity, Sound forge etc.

### UNIT-III

IMAGES - Importance of Images Graphics in Multimedia, Vector and Raster Graphics, Regular Graphics vs. Interlaced Graphics, Image Capturing Methods - Scanner, Digital Camera Etc. Color models-RGB, CYMK, Hue, Saturation, and Brightness, Various Attributes of Images Size, Color, Depth Etc, Various Image File Format BMP, DIB, CIF, PIC, and TIF Format Their Features And Limitations, Image format conversion, various effects on images. Create images using Photoshop, CorelDraw and apply various effects, Using Layers, Channels and Masks in images.

### UNIT-IV

VIDEO- Basic of Video, Analog and Digital Video Type of Video, Digitization of Analog Video, Video Standard – NTSC, Pal, HDTV, Video Capturing Media /Instruments Videodisk Camcorder Compression Techniques, File Formats AVI, MJPG, MPEG, Video Editing and Movie Making Tools, converting formats of videos, recording and editing videos using video editing software like adobe premiere or Sony Vegas.

### UNIT-V

ANIMATION- Concepts of animation, 2D and 3D animation, tools for creating animation, character and text animation, creating simple animation using GIF animator and flash, Morphing and Applications.

Authoring tools for Multimedia – Introduction to various types of multimedia authoring tools, CD/DVD based and web based tools, features and limitations, creating multimedia package using all components.

### Reference Books:

1. Multimedia & Its Applications, V.K. Jain, Khanna Publishing House
2. Fundamentals of Multimedia, Ramesh Bangia, Khanna Publishing House

## Data Structure Lab

1. Implement stack. Write functions like push, pop, Initialize, Empty or Full. 2
2. WAP to Convert the Infix expression into postfix using STACK.
3. WAP to Convert the Infix expression into Prefix using STACK. 4
4. Implement concept of queues
5. Implement circular Queue using Array.
6. WAP to implement STACK using Link List
7. WAP to implement Queue using Link List
8. Implement queues as a circular linked list. 9
9. Implementing doubly linked list
10. Binary search tree to sort an array

## Java Lab

1. Write a Program to accept a String as a Command line argument and the program should print a Welcome message.
2. Create a class Box that uses a parameterized method to initialize the dimensions of a box.(dimensions are width, height, depth of double type). The class should have a method that can return volume. Obtain an object and print the corresponding volume in main() function.
3. Write a Program that will check whether a given String is Palindrome or not
4. Write a Java Program for Multiplication of two matrices.
5. Write a program to check if given String is Palindrome or not.
6. Given two strings, append them together (known as "concatenation") and return the result. However, if the concatenation creates a double-char, then omit one of the chars. If the inputs are "Mark" and "Kate" then the output should be "markate".
7. Create an abstract class Instrument which is having the abstract function play. Create three more sub classes from Instrument which is Piano, Flute, Guitar. Override the play method inside all three classes printing a message  
"Piano is playing tantantantan" for Piano class  
"Flute is playing tootootootootoot" for Flute class  
"Guitar is playing tintintin" for Guitar class
8. Write a program that takes as input the size of the array and the elements in the array. The program then asks the user to enter a particular index and prints the element at that index. This program may generate Array Index Out Of Bounds Exception. Use exception handling mechanisms to handle this exception. In the catch block, print the class name of the exception thrown.
9. Create two threads and assign names 'Scooby' and 'Shaggy' to the two threads. Display both thread names.
10. Write an Applet program in Java to display "Welcome to Java".

## Level 6 (Semester III)

### Linux Operating System - Operations & Management

#### UNIT – I

Linux introduction and file system - Basic Features, Advantages, Installing requirement, Basic Architecture of Unix/Linux system, Kernel, Shell.

Linux File system-Boot block, super block, Inode table, data blocks, How Linux access files, storage files, Linux standard directories, Commands for files and directories cd, ls, cp, md, rm, mkdir, rmdir, more, less, creating and viewing files, using cat, file comparisons, View files, disk related commands, checking disk free spaces, Partitioning the Hard drive for Linux, Installing the Linux system, System startup and shut-down.

#### UNIT-II

Essential Linux commands Understanding shells, Processes in Linux process fundamentals, connecting processes with pipes, redirecting input output, manual help, Background processing, managing multiple processes, changing process priority, scheduling of processes at command, batch commands, kill, ps, who, sleep, Printing commands, grape, fgrep, find, sort, Cal, banner, touch, file,file related commands-ws, sat, cut, grep, dd, etc.Mathematical commands- bc, expr, factor, units.vi, joe, vim editor

#### UNIT-III

Shell programming Basic of shell programming, Various types of shell, shell programming in bash, conditional and looping statements, case statements, parameter passing and arguments, Shell variables, shell keywords, Creating Shell programs for automate system tasks and report printing, use of grep in shell, awk programming.

#### UNIT-IV

System administration Common administrative tasks, identifying administrative files – configuration and log files, Role of system administrator, Managing user accounts-adding & deleting users, changing permissions and ownerships, Creating and managing groups, modifying group attributes, Temporary disable user's accounts, creating and mounting file system, checking and monitoring system performance file security & Permissions, becoming super user using su.Getting system information - host name, disk partitions & sizes, users, kernel.

Backup and restore files, linuxconf. utility in GUI, reconfiguration hardware with kudzu Configure desktop-X configurator, understanding XF86config file, starting & using X desktop. KDE & Gnome graphical interfaces, changing X settings.

#### UNIT-V

Basic networking administration Setting up a LAN using Linux, choosing peer to peer vs client/server model, setting up an Ethernet Lan, configuring host computers, checking Ethernet connecting, connecting to internet, administration in a networked environment, common networking administrative tasks, the network file system, configuring Ethernet, initializing Ethernet Interface, ifconfig, netstat and netconfig commands a TCP/IP networks, DNS services, routing using Linux, SLIP & PPP services, UUCP.Installation & Administration of mail server, ftp server and Apache web server.

## **(Software Engineering**

### **UNIT - I**

SOFTWARE : Software Characteristics, Components & Applications, Software Engineering - A Layered Technology, Software Process Models - Linear Sequential Model, Prototype & Rad Model., Evolutionary Software Process Model – Incremental Model and Spiral Model.

SOFTWARE PROJECT MANAGEMENT: Project Management Concepts – People Problem and Process S/W process and Project Metrics : Metrics in The Process and Project Domains . Software Measurement –Size Oriented, Function Oriented Metrics, ExtendedFunction

### **UNIT - II**

SOFTWARE PROJECT PLANNING: Objectives, Scope, Project Estimation, Decomposition Techniques, Empirical Estimation Models.

ANALYSIS CONCEPT AND PRINCIPLES: Requirement Analysis, Communication Techniques, Analysis Principles, Software Prototyping, Specifications.

ANALYSIS MODELING: Elements of The Analysis Modeling, Data Modeling. Functional Modeling and Information Flow, Behavioral Modeling, Data Dictionary.

### **UNIT – III**

DESIGN CONCEPTS AND PRINCIPLES: Design Process, Design Concepts, Design Principles, Effective Modular Design. DESIGN METHODS : Architectural Design Process, Transform Mapping and Transaction Mapping, Interface Design, - Internal and External Design, Human Computer Interface Design, Interface Design Guidelines, Procedural Design.

### **UNIT - IV**

S/W Quality Assurance : Quality Concepts, Matrix for Software Quality, Quality Movement, S/W Q A, S/W Review, Formal Technical Reviews, Formal Approaches to SQA, S/W Reliability, ISO 9000 quality Standards S/W TESTING MODELS : S/W Testing Fundamentals, Test Case Design, White and Black Box Testing, Basic Path Testing, Control Structure

S/W TESTING STRATEGIES : Strategic Approach To S/W Testing, Unit Testing, Integration Testing, Validation Testing, System Testing, Debugging

### **UNIT - V**

S/W REUSE : Reuse Process, Building Reuse Components, Classified And Retrieving Components, Economics Of S/W Reuse COMPUTER AIDED S/W ENGINEERING: Introducing of Case, Building Block For Case, Taxonomy Of Case Tools, Integrating Case Environment, Integrating Architecture, Case Repository.

#### **Reference Books:**

1. Software Engineering, N.S. Gill, Khanna Publishing House
2. Software Engineering, R.P. Mahapatra, Khanna Publishing House

## **Web Development using PHP**

### **UNIT I**

Introduction to PHP as a programming Language: - Advantages of PHP, the server side architecture Decomposed, overview of PHP, history, object oriented support, benefits in running PHP as a server side script. Installing a web server, Internet information server, and IIS installation, testing web server setup.

### **UNIT II**

The basics of PHP: - data types, variables, constants, operators, Arrays, Conditional statements (if statement, Executing Multiple Statements, else if clause and switch statement), Iterations (for loop, while loop, controlling an array using a while loop, do while statement, for each loop and special loop key words)

### **UNIT III**

Functions, user defined functions, functions with arguments, built in functions (print(), includer(), header(), phpinfo() ), PHP server Variables, working with date and time , performing mathematical operations , working with string functions . System Variable (GET, POST, cookies& Session, Forums)

### **UNIT IV**

Working with forms, form elements (Text Box, Text Area, Password, Radio Button, Checkbox, The Combo Box, Hidden Field and image), adding elements to a form, uploading files to the Web Server using PHP, building a challenge and response subsystem and understanding the functionality of the FORM attribute Method Regular Expressions: - Engine, types of Regular Expressions, symbols used in Regular Expressions. Error handling in PHP: - Displaying errors, warnings, types of errors, error levels in PHP, logging Errors and Ignoring errors.

### **UNIT V**

Data base connectivity using PHP (MySQL, ODBC, ORACLE, SQL) Performing, executing Commands, different types of Data Base Operations like Insertion, deletion, update and query on data


#### **Reference Books:**

1. Mastering PHP, WebTech Solutions, Khanna Publishing House
2. Learning PHP, Ramesh Bangia, Khanna Publishing House

### **Window Development Fundamentals**

1. Programming web applications
2. Working with data and services
3. Troubleshooting and debugging web applications
4. Working with client-side scripting
5. Configuring and deploying web applications
6. Understanding core programming
7. Understanding object-oriented programming
8. Understanding general software development
9. Understanding web applications
10. Understanding desktop applications
11. Understanding databases

#### **Reference Books:**

1. Internet and Web Development, Soma Das Gupta, Khanna Publishing House
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### Web Development using PHP Lab

1. Write a program to display "Hello World".
2. Write a program to print an array of Strings.
3. Write a program to print each element of an array using foreach().
4. Write a program to find number of elements in an array.
5. Write a program to sort elements in an array in ascending order.
6. Write a program to find the sum of elements in an array.
7. Write a program to find the product of elements in an array.
8. Write a program to split a string as array elements based on delimiter.
9. Write a program to combine the array elements into a string with given delimiter.
10. Write a program to join the array elements into a string.
11. 1. Write a program to merge two arrays into a new array.
12. 2. Write a program to remove the duplicated values from an array.
13. Write a programs to create simple Login and Logout using sessions.
14. Write a program to Upload a file to the Server.
15. Write a program to connect to the server and selecting database.
16. Write a program to Insert records to the table in Database.
17. Write a program to fetch records from the table in Database.
18. Write a program to Store and Read an image in Database.
19. Write a program to create a simple Registration form.
20. A simple CRUD operations using PHP and Mysql.

### Window Development Fundamentals Lab

1. Client-side scripting Programs
2. Deploying web applications
3. Basic object-oriented programs
4. Understanding desktop applications
5. Basic SQL Queries



## Level 6 (Semester IV)

### Software Testing & Project Management

#### UNIT - I

Testing basics and Development Models: Principals and context of testing in software production, Usability and Accessibility Testing, Phases of Software Project, Process models to represents different phases, Software Quality Control and its relation with testing, validating and verification, Software Development life cycle models, various development models.

White Box Testing: White Box Testing - Static Testing, Structural Testing-Unit code functional testing, Code coverage testing, code complexity testing,

Black Box Testing- What? Why and when to do Black box testing, Requirements based testing, Positive and Negative Testing, Boundary value testing, Decision Tables, Equivalence Partitioning, State Based or Graph Based Testing, Compatibility Testing, User Documentation Testing, Domain Testing.

#### UNIT - II

Integration Testing: Introduction and types of integration testing, Scenario testing, defect bash. System and Acceptance Testing- Overview, functional and non-functional testing, Acceptance testing.

Overview of some software testing tools: WinRunner, LoadRunner, Test Director.

(Some practical should be conducted using these tools)

#### UNIT- III

Performance Testing- Introduction, factors related to performance testing, methodology for performing testing, Regression Testing,

Ad hoc Testing- Overview, Buddy & pair testing, Exploratory testing, Interactive testing, Agile and extreme testing. Testing of Object Oriented Testing – Introduction, Differences in OO testing.

#### UNIT – IV

Software Project Management: Overview, Software Project Management Framework, Software Development life cycle,

Organization Issues and Project Management, Managing Processes, Project Execution, Problems in Software Projects, Project Management Myths and its clarifications.

Software Project Scope: Need to scope a software project, scope management process, communication techniques and tools, communication methodology

Software Requirement Gathering and Resource allocation: Requirement specifications, SRS Document preparation, Resources types for a software projects, requirement for resources allocation.

#### UNIT – V

Software Project Estimation: Work Breakdown structure (WBS), steps in WBS, Measuring efforts for a project, techniques for estimation – SLOC, FP, COCOMO and Delphi methods.

Project Scheduling: Scheduling and its need, scheduling basics, Gantt Chart, Network scheduling techniques, Pert and CPM. Using a Project Management Tool: Introduction to MS Project 2000, Managing tasks in MS Project 2000, Tracing a project plan, creating and displaying project information reports.

## Android Application Development

### UNIT-I

Android Introduction, Smartphones future, Preparing the Environment, Installing the SDK, Creating Android Emulator, Installing and Using Eclipse, Installing Android Development Tools, Choosing which Android version to use Android Architecture, Android Stack, Android applications structure Creating a project, Working with the AndroidManifest.xml, Using the log system Activities Introduction to UI – Layouts, Fragments, Adapters, Action bar, Dialogs, Notifications , UI best practices

UI Architecture, Application context, Intents, Activity life cycle, Supporting multiple screen sizes

### Unit – II

Designing User Interface Using Views – Basic Views- TextView, Button, Image Button, Check Box, Toggle Button, Radio Button etc., Progress Bar View and Auto Complete Text View, Time Picker and Date Picker View, List View,

Image View, Image Switcher and Grid View, Digital Clock & Analog Clock Views Notification and Toast, Parameters , on Intents, Pending intents, Status bar notifications Toast notifications.

### UNIT-III

Menus, Localization, Options menu, Context menu Dialogs-Alert dialog, Custom dialog, Dialog as Activity Orientation and Movement- Pitch, roll and yaw, Natural device orientation, Reference frame remapping SMS - Sending and Receiving Working with Media –Playing audio and video, Recording audio and video.

### UNIT-IV

Location and Maps - Google maps, Using GPS to find current location.

Working with data storage - Shared preferences, Preferences activity, Files access, Using External storage, SQLite database Animation-View animation, Drawable animation Working with Sensors - Finding sensors, Accelerometers, Gyroscopes, Other types Working with Camera – Controlling the camera, Preview and overlays, Taking pictures

### UNIT-V

Content providers- Content provider introduction, Query providers

Network Communication - Web Services, HTTP Client, XML and JSON, Using e-mails.

Services - Service lifecycle, Foreground service, Creating own services

Publishing and Distributing Your App -Preparing for publishing, Google Play requirements, Signing and preparing the graphics, Publishing to the Android Market, Monetization, Tips on becoming a top app, Google analytics

Reference Books:

Learning Android, Ramesh Bangia, Khanna Publishing House

## Windows Configuration and Server Administration

**Understanding Windows Programming Basics:** Identify Windows application types, Implement user interface design.

**Creating Windows Forms Applications:** Create and handle events, Understand Windows Forms inheritance, understand how to create new controls and extend existing controls, Validate and implement user input, Debug a Windows-based application.

**Creating Windows Services Applications:** Create a Windows Services application, Install a Windows Services application.

**Accessing Data in a Windows Forms Application:** Understand data access methods for a Windows Application, Understand data bound controls.

**Deploying a Windows Application:** Understand windows application deployment methods, integrating data.

**Network basics:** Type of Networks, Topologies, Transmission media, Install UTP (Straight, Cross, Rollover Cables), IP Addressing, Subnetting, OSI Model, TCP/IP Model, Wireless Network, Network Devices.

**Installation:** Installation Server, Drivers, Working with windows server Devices, Troubleshooting Devices & Drivers, Managing system updates.

**Working With Disk Storage:** Type of Disk Storage, Type of volumes, Implementing fault tolerance, Use disk management tools, Disk Quota, Troubleshooting disk management, Shadow copy. **Domain Controller:** Install Active Directory, Manage Active Directory Component, Working with OU Structure, Working with Domain User account, Working with Domain Groups, Troubleshooting Active Directory.

**Domain Name Services (DNS):** Define Name resolution, Install DNS, Configure DNS Client, Manage and Troubleshoot DNS.

**Dynamic Host Configuration Protocol:** Configure DNS Server, Working With Super Scope, Configure DHCP Client, Manage and Troubleshoot DHCP Server.

**Backup and Restore:** Requirement for Backup and Recovery AD, Issue for AD Backup and Recovery, Steps for Backup and Recovery AD.

## **Management Information System**

### **Unit I**

An introduction to information systems, Information systems in organizations, Information Technology Concepts, The IS Revolution; Information requirement for the different levels of management, transaction processing system, Management information system, Decision support system. Strategic Role of Information Systems. Business Processes; Information management, and Decision Making. Computers and Information Processing;

### **Unit II**

Transaction processing system; hardware and software requirements, tools used, case studies, merits and demerits of transaction processing system.

### **Unit III**

Managerial control, Information and tools required, difference between transactional system and managerial system. Frequency of taking outputs, Need for interconnected system, common database, Redundancy control, case studies. Decision support system, concept and tools, case studies, virtual organizations, strategic decisions-unstructured approach, cost and values of unstructured information.

### **Unit IV**

Optimization techniques, difference between optimization tools and DSS tools expert system, difference between expert system and management information system. Role of chief Information officer.

## **Android Application Development Lab**

1. Write a simple Application which will print "Hello World!"
2. Write a simple Application that uses UI Layout and Control.
3. Write a simple Application that makes use of Style & Themes.
4. Write a simple Application that uses Event Handling.
5. Write a simple Application that uses Alarm, Notification.
6. Make a location based app.
7. Write a program that shows the use animation.
8. Write a program that shows the use of Image Effects.
9. Write a program that shows the use Image Switcher.
10. Write a program that shows the use of database.

### **MIS Lab**

Experiments to be covered based on the theory covered in class

**Level 7 (Semester V)**  
**Technology Trends in IT**

**Unit-I**

**Internet of Things (IoT)** –Definition of IoT, History of IoT, IoT vs. similar concepts,Application/Segment overview, Technology overview

**Unit-II**

**Big Data Analytics:** Concepts, examples of big data analytics, benefits of big data analytics,Technologies, and Applications, requirements for being successful with big data analytics

**Unit-III**

**Cloud Computing – Introduction,** Why cloud services are popular, advantages, Characteristics,Service models, Deployment of cloud services, Potential privacy risks

**Unit-IV**

**Cyber Security – Introduction, risks,** Malicious code, Hacker, attacker or intruder, Cyber securityPrinciples, Information Security (IS) within Lifecycle Management, Risks & Vulnerabilities, Incident Response, Future Implications & Evolving Technologies

**Unit-V**

**Wearable Technologies – Introduction,** Applications of Wearable Technology, Challenges toWearable Technology, various Wearable devices.

**Reference Books:**

1. Computer Today, A. Ravichandran, Khanna Publishing House
2. Internet of Things, Jeeva Jose, Khanna Publishing House
3. Big Data and Hadoop, V.K. Jain, Khanna Publishing House
4. Data Sciences and Analytics, V.K. Jain, Khanna Publishing House

**Windows Mobile Application Development**

**Unit-I**

INTRODUCTION TO WINDOWS 8 APPLICATION DEVELOPMENT - brief history of windows application development, History of APIs and Tools, Operating System Input Methods

The Windows Charm Bar, Start Button, Search Button, Share Button, Devices Button, Settings Button, Windows Desktop, Switching between Desktop Programs

WINDOWS 8 ARCHITECTURE FROM A DEVELOPER'S POINT OF VIEW - Windows 8 Development Architecture, Desktop Application Layers, Understanding Windows Runtime: Windows Runtime Architecture Overview, Metadata in Windows Runtime, .NET Framework 4.5: The Installation Model of .NET Framework 4.5, Window Runtime Integration, Picking the Appropriate Technology for Your Project, Choosing a Programming Language

GETTING TO KNOW DEVELOPMENT ENVIRONMENT - Introducing the Toolset, Visual Studio IDE:

Creating a New Project, Lighting Up Your Applications with Expression Blend

#### **UNIT-II**

PRINCIPLES OF MODERN WINDOWS APPLICATION DEVELOPMENT - Windows 8 Style Application, Windows 8 Design Language, Introduction to Asynchronous Programming, Evolution of Asynchronous, Programming on the .NET Platform

CREATING WINDOWS 8 STYLE APPLICATIONS WITH HTML5, CSS, AND JAVASCRIPT - HTML5 and CSS on the Web, HTML5 Technologies, HTML5 Applications on Windows Runtime, The Windows Library for JavaScript (WinJS), Creating Windows 8 Style Applications with JavaScript, Accessing the Filesystem, Managing Data, Respecting the User's Device

#### **UNIT-III**

USING XAML TO CREATE WINDOWS 8 STYLE USER INTERFACES - Describing the User Interface Using XAML, Using Namespaces, Understanding the Layout Management System, Reusable Resources in XAML, Basic Controls in Windows 8 Style Applications: Controls with Simply Accessing the Internet: e Values, Content Controls, Working with Data: Data Binding Dependency Properties and Notifications, Binding Modes and Directions

WORKING WITH XAML CONTROLS - Using Animations in Application, Designing the Visual Look of a Control, Working with Complex Controls: Getting to Know the List View Base Controls, Using the Grid View Control, Binding to Data, Grouping Data, Defining Visual Groups

BUILDING WINDOWS 8 STYLE APPLICATIONS - The Lifecycle of a Windows 8 Application, Deploying Windows 8 Apps, Commanding Surfaces, Persisting Application Data, Applications and the Start Screen

#### **UNIT-IV**

CREATING MULTI-PAGE APPLICATIONS - Navigation Basics, working with Pages, Using the Split Application and Grid Application Templates

BUILDING CONNECTED APPLICATIONS - Integrating with the Operating System and Other Apps: Picker Unified Design to Access Data, Understanding the Concept of Contracts, Accessing the Internet: Detecting the Changes of Internet Connectivity, Using Feeds, Accessing Windows Live  
LEVERAGING TABLET FEATURES - Accommodating Tablet Devices, Building Location-Aware Applications, Using Sensors: Using Raw Sensor Data, Using Sensor Fusion Data

#### **UNIT-V**

ADVANCED PROGRAMMING CONCEPTS - Building Solutions with Multiple Languages: Hybrid Solutions, Background Tasks: Understanding Background Tasks, How Background Tasks Work,

Cancelling Background Tasks, Implementing Background Tasks, creating a Simple Background Task, Managing Task Progress and Cancellation, Input Devices

TESTING AND DEBUGGING WINDOWS 8 APPLICATIONS - The Quality of Software, Becoming Familiar with Debugging, Controlling the Program Flow in Debug Mode, Monitoring and Editing Variables, Changing the Code While Debugging, Windows 8 Style Application-Specific Scenarios, Introduction to Software Testing, Introduction to Unit Testing, Unit Testing Windows 8 Style Applications

INTRODUCING THE WINDOWS STORE - Getting to Know the Windows Store, How Customers See an App in the Windows Store, Application Details, Making Money with Your App, The Developer Registration Process: Submitting the Application, The Application Certification Process, The Windows App Certification Kit.

### **Introduction to Python Programming**

- Familiarization with the basics of Python programming: a simple "hello world" program, process of writing a program, running it, and print statements; simple data-types: integer, float, string
- Introduce the notion of a variable, and methods to manipulate it (concept of L-value and R-value even if not taught explicitly)
- Knowledge of data types and operators: accepting input from the console, assignment statement, expressions, operators and their precedence.
- Conditional statements: if, if-else, if-elif-else; simple programs: e.g.: absolute value, sort numbers, and divisibility.
- Notion of iterative computation and control flow: for, while, flowcharts, decision trees
- and pseudo code; write a lot of programs: interest calculation, primarily testing, and factorials.
- Idea of debugging: errors and exceptions; debugging: pdb, break points.
- Lists, tuples and dictionary: finding the maximum, minimum, mean; linear search on list/tuple of numbers, and counting the frequency of elements in a list using a dictionary. Introduce the notion of accessing elements in a collection using numbers and names.
- Sorting algorithm: bubble and insertion sort; count the number of operations while sorting.

- Strings: compare, concat, substring; notion of states and transitions using state transition diagrams.

**Reference Books:**

1. Introduction to Computing and Problem Solving With Python, Jeeva Jose, Khanna Publishing House
2. Taming Python by Programming, Jeeva Jose, Khanna Publishing House

**Introduction to Microprocessors**

**Digital Design and VHDL**

Introduction  
Combinational Logic  
Structural Modeling  
Sequential Logic  
Finite State Machines  
Parameterized Modules  
Testbenches

**Arithmetic Logic Unit (ALU)**

1. Introduction
2. Arithmetic Circuits
3. ALU
4. Number Systems

**Microprocessor I: Instruction Data Set. Machine Language**

1. Introduction
2. Assembly Language
3. Machine Language
4. Programming
5. Addressing Modes
6. Lights, Camera, Action: Compiling, Assembling, and Loading
7. Odds and Ends

**Microprocessor II: Control and Datapath Design. Single-Cycle Processor**

1. Introduction
2. Performance Analysis
3. Single-Cycle Processor

**Microprocessor III: Control and Datapath Design. Multi-cycle Processor**

1. Introduction
2. Performance Analysis
3. Multicycle Processor
4. Pipelined Processor



**Memory systems and I/O.**

Introduction

Memory System

Caches

Virtual Memory

Memory-Mapped I/O

Memory map

I/O Devices

Buses and organization

**Reference Books:**

1. Fundamentals of Microprocessor, M.K. Ghodki, Khanna Publishing House
2. Advance Microprocessor, A.K. Gautam, Khanna Publishing House

### Windows Mobile Application Development Lab

1. Working with J2ME Features
2. Threads & High level UI
3. Developing networked applications using the wireless toolkit
4. Authentication with a webserver
5. Study Windows API's. Find out their relationship with MFC classes. Appreciate how they are helpful in finding complexities of windows programming.

### Python Programming Lab

1. Python Program to Print Hello world!
2. Python Program to Add Two Numbers
3. Python Program to Check if a Number is Odd or Even
4. Python Program to Solve Quadratic Equation
5. Python Program to Check Armstrong Number
6. Python Program to Find the Sum of Natural Numbers
7. Write a Python program to get unique values from a list
8. Python Program to Illustrate Different Tuple Operations
9. Python Program to Check Whether a String is Palindrome or Not
10. Write a Python program to remove duplicates from Dictionary
1. Write a Python program to sort a list alphabetically in dictionary
2. Python Program to Illustrate Different Set Operations (Union, Intersection, Difference and Symmetric Difference)
3. Python Program to illustrate the concept of Binary Relations in Set.
4. Python Program to Generate a Random Number
5. Python Program to Convert Decimal to Binary, Octal and Hexadecimal
6. Python Program to Find HCF or GCD
17. Given two integers x and n, compute  $x^n$ .
18. Python Program to Find Factors of Number
19. Python Program to Make a Simple Calculator
20. Python Program to Find Factorial of Number Using Recursion

**Level 7 (Semester VI)**  
**Introduction to AI**

**UNIT – I**

Overview of A.I: Introduction to AI, Importance of AI, AI and its related field, AI techniques, Criteria for success. Problems, problem space and search: Defining the problem as a state space search, Production system and its characteristics, Issues in the design of the search problem Heuristic search techniques : Generate and test, hill climbing, best first search technique, problem reduction, constraint satisfaction

**UNIT - II**

Knowledge Representation: Definition and importance of knowledge, Knowledge representation, Various approaches used in knowledge representation, Issues in knowledge representation. Using Predicate Logic: Representing Simple Facts in logic, Representing instances and is-a relationship, Computable function and predicate.

**UNIT - III**

Natural language processing: Introduction syntactic processing, Semantic processing, Discourse and pragmatic processing. Learning: Introduction learning, Rote learning, Learning by taking advice, Learning in problem solving, Learning from example-induction, Explanation based learning.

**UNIT - IV**

Expert System: Introduction, Representing using domain specific knowledge, Expert system shells. Knowledge acquisition: General concepts in knowledge acquisition, early work in Machine Learning, examples of Inductive Learners, computer vision, Robotics, overview of LISP- AI language.

Reference Books:

1. Artificial Intelligence, Munish Chandra Trivedi, Khanna Publishing House

**OR**

**Computer Network Security**

**UNIT-I**

Network Concept, Benefits of Network, Network classification (PAN, LAN, MAN, WAN), Peer to Peer, Client Server architecture, Transmission media: Guided & Unguided, Network Topologies. Networking terms: DNS, URL, client server architecture, TCP/IP, FTP, HTTP, HTTPS, SMTP, Telnet OSI and TCP/IP Models: Layers and their basic functions and Protocols, Comparison of OSI and TCP/IP. Networking Devices: Hubs, Switches, Routers, Bridges, Repeaters, Gateways and Modems, ADSL.

**UNIT-II**

Ethernet Networking: Half and Full-Duplex Ethernet, Ethernet at the Data Link Layer, Ethernet at the Physical Layer. Switching Technologies: layer-2 switching, address learning in layer-2 switches,

network loop problems in layer-2 switched networks, Spanning-Tree Protocol, LAN switch types and working with layer-2 switches, Wireless LAN

#### **UNIT- III**

Internet layer Protocol: Internet Protocol, ICMP, ARP, RARP. IP Addressing: Different classes of IP addresses, Sub-netting for an internet work, Classless Addressing. Comparative study of IPv4 & IPv6. Introduction to Router Configuration. Introduction to Virtual LAN.

#### **UNIT- IV**

Transport Layer: Functions of transport layer, Difference between working of TCP and UDP. Application Layer: Domain Name System (DNS), Remote logging, Telnet, FTP, HTTP, HTTPS. Introduction to Network Security.

#### **Reference Books:**

1. Information & Computer Security, Sarika Gupta, Khanna Publishing House
2. An Integrated Approach to Computer Networks, Bhavneet Sidhu, Khanna Publishing House

## **e-Commerce**

### **Unit I**

Introduction E-Business: Origin and Need of E-Commerce, Factors affecting E -Commerce, Business dimension and technological dimension of E-Commerce, E-Commerce frame work Electronic Commerce Models, Value Chains in Electronic Commerce.

### **Unit II**

Internet and E-Business: Introduction to Internet and its application, Intranet and Extranets. World Wide Web, Internet Architectures, Internet Applications, Business Applications on Internet, E - Shopping, Electronic Data Interchange, Components of Electronic Data Interchange, Creating Web Pages using HTML.

### **Unit III**

Technology for Online Business: Internet, IT Infrastructure, Middleware Contents, Text and Integrating E-Business Applications, Mechanism of Making Payment Through Internet, Online Payment Mechanism, Electronic Payment Systems, Payment Gateways, Visitors to Software Development Website, Tools for Promoting Website, Plastic Money, Debit Card, Credit Card, Laws Relating to Online Transactions.

### **Unit IV**

Applications in E-commerce: E-commerce Applications in Manufacturing, Wholesale, Retail and Service Sector.

### **Reference Books:**

1. E-Commerce, Sarika Gupta, Khanna Publishing House

**OR**

## **Introduction to Biometrics**

### **Unit I**

Concepts - biometric recognition, biometrics, requirements for biometrics  
Biometric systems, their modes and architectures, Biometric system errors and evaluation,  
Software Development

### **Unit II**

Overview, comparison and evaluation of various biometrics  
Unimodal biometric systems, their advantages, disadvantages and limits  
Multimodal biometric systems, their modes of operation, levels of fusion

### **Unit III**

Biometric pattern recognition methods  
Privacy protection and social acceptance  
Biometric standardization, data formats  
Design and implementation of biometric systems, applications of biometric systems, biometric databases, security of biometric systems

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc.**

**Graphics & Multimedia (GM)**

**Branch code:107**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

**EVALUATION SCHEME**  
**Graphics & Multimedia**

Level 5 SEMESTER- I											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BGMV511	Web Applications	30	10	5	5	20	30		50	2
2	BGMV512	Communication Skill-I	30	10	5	5	20	30		50	2
3	BGMV513	Graphic Design (Basic Sketching and Human Anatomy in Drawing)	30	10	5	5	20	30		50	2
4	BGMV514	Illustration And Photo-Editing	30	10	5	5	20	30		50	2
6	BGMP511	Web Applications –Lab	30				20		30	50	1
7	BGMP512	Illustration And Photo-Editing –Lab	30				20		30	50	1
8	BGMP513	Language Lab	30				20		30	50	2
9	BGMT511	Character Designer MES/Q0502						Any one Training 400 hrs / 8 weeks	150	12	
	BGMT512	Storyboard Artist MES/Q0507									
	BGMT513	Editor MES/Q1401									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 5 SEMESTER- II													
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit		
				CT	TA	AT	Total	TE	PE				
1	BGMV521	Pre-Production	30	10	5	5	20	30		50	2		
2	BGMV522	Audio Editing	30	10	5	5	20	30		50	2		
3	BGMV523	Video Editing	30	10	5	5	20	30		50	2		
4	BGMV524	Communication Skill- II	30	10	5	5	20	30		50	2		
6	BGMP521	Audio Editing-Lab	30				20		30	50	1		
7	BGMP522	Video Editing-Lab	30				20		30	50	1		
8	BGMP523	IT Tool Lab	30				20		30	50	2		
9	BGMT521	Any one of the QP's can be opted as offered in Semester I						Any one Training 400 hrs/ 8 weeks	150	12			
<b>Total</b>			<b>610</b>									<b>500</b>	<b>24</b>

NSFQ Level 6 SEMESTER- III											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BGMV631	Principles of Animation and Techniques of Animation	30	10	5	5	20	30		50	2
2	BGMV632	Basic of 3-D Modelling	30	10	5	5	20	30		50	2
3	BGMV633	Texture and Lighting	30	10	5	5	20	30		50	2
4	BGMV634	Communication Skill-III	30	10	5	5	20	30		50	2
5	BKVH631	Human Values and Professional Ethics	30	10	5	5	20	30		50	2
6	BGMP631	Digital Animation with Flash - Lab	30				20		30	50	1
7	BGMP632	Maya – Lab	30				20		30	50	1
8	BGMT631	Modeller MES/Q2501							Any one Training 400 hrs/ 8 weeks	150	12
	BGMT632	Animator MES/Q0701									
	BGMT633	Rendering Artist MES/Q3503									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>
NSFQ Level 6 SEMESTER- IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BGMV641	3 D Animation	30	10	5	5	20	30		50	2
2	BGMV642	Introduction to 3 D Motion Graphics & VFX	30	10	5	5	20	30		50	2
3	BGMV643	Introduction to Rendering	30	10	5	5	20	30		50	2
4	BGMV644	Communication Skill-IV	30	10	5	5	20	30		50	2
5	BKVE641	Environment and Ecology	30	10	5	5	20	30		50	2
6	BGMP641	3 D Animation Lab	30				20		30	50	1
7	BGMP642	Rendering-Lab	30				20		30	50	1
8	BGMT641	Any one of the QP's can be opted as offered in Semester III							Any one Training 400 hrs/ 8 weeks	150	12
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>



NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credits
				CT	TA	AT	Total	TE	PE		
1	BGMV751	Digital Compositing	30	10	5	5	20	30		50	2
2	BGMV752	3 D Texturing	30	10	5	5	20	30		50	2
3	BGMV753	Basic of Accounts-I	30	10	5	5	20	30		50	2
4	BGMV754	Computer Graphics	30	10	5	5	20	30		50	2
5	BKVH751	Constitution of India, Law and Engineering	30								2
6	BGMP751	Digital Compositing-Lab	30				20		30	50	1
7	BGMP752	3 D Texturing –Lab	30				20		30	50	1
8	BGMT751	Compositor MES/Q3505						Any one Training 400 hrs/ 8 weeks		150	12
	BGMT752	Texturing Artist MES/Q2503									
	BGMT753	Rigging Artist MES/Q2502									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credits
				CT	TA	AT	Total	TE	PE		
1	BGMV761	Muscle System	30	10	5	5	20	30		50	2
2	BGMV762	Rigging	30	10	5	5	20	30		50	2
3	BKVH761	Indian Tradition, Culture and Society	30	10	5	5	20	30		50	2
4	BGMP761	Major Project	180					30	150	150	6
5	BGMT761	Any one of the QP's can be opted as offered in Semester V						Any one Training 400 hrs/ 6 weeks		200	12
<b>Total</b>			<b>670</b>								

## Detailed Curriculum

### Software Requirements to run the B. Voc (Graphics and Multimedia)

1. Adobe Illustrator (Vector graphic design software)
2. Adobe Photoshop
3. Sound Forge
4. Adobe Premiere Pro
5. Autodesk 3DS Max
6. Autodesk Maya
7. ZBrush

### Level 5 (Semester I)

#### Web Applications

#### Bridge Course

#### Introduction to Database Management

Introduction to database concepts and its need

Database Terminology: Data, Record/Tuple, Table, Database, field/attribute

#### Networking And Open Standards

Computer Networking: Evolution of Networking: ARPANET, WWW, Internet

Network Topologies: Bus, Star, Tree

Types of Network: PAN, LAN, WAN, MAN

#### Web Page Development

Review of HTML/DHTML, JavaScript covered in Class XI

Installation and Managing WEB-Server: IIS/XAMPP/LAMP

Movie Editing Tools.

1. Familiarization of interface components.
2. Importing pictures.
3. Importing Audio and Video Files.
4. Splitting and Joining Movie Clips.
5. Adding Titles and publishing.
6. Compatible Multimedia file formats for Web Pages.
7. Embedding Audio file.
8. Embedding Video file.
9. Embedding Flash file.
10. Java Script review.
11. Functions – user defined.

12. String Object.
13. Math Object.
14. Array Object.
15. Events.
16. Case Studies.
17. Advanced Features of Web Design.
18. Code view, Add-ins / Snippets and Page Transitions.
19. Dynamic Web templates.
20. SEO - Search Engine Optimization.
21. Forms - Advanced.
22. Publishing webpages or websites-I.

**Reference Books:**

1. Internet & Web Development, Soma Das Gupta, Khanna Publishing House

**Communication Skill -I**

*Communication Process:* The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

*Structural and Functional Grammar:* Sentence structure, modifiers, connecting words and verbals; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles;

**Reference Books:**

1. Effective Communication Skills, Kulbhushan Kumar, Khanna Publishing House

**Graphic Design(Basic Sketching and Human Anatomy in Drawing)**

Bridge Course

**Design Processes and Practices**

Role of Design in Society, Functions of Design, Implications and Impact of Graphic Design Role of Graphic Designer , Contemporary Graphic Design in India , Graphic Design Processes

Methodology of Graphic Design

**Principles and Elements of Design**

Sketching and Drawing, Introduction to Drawing: an aid in visual representation, Types of drawing  
Drawing from memory and imagination  
Drawing from observation  
Drawing from Dimensional information, Virtues of drawing, Colour, Colours theories, Colour  
wheel, Colour Harmonies or Colour Schemes, Colour Symbolism

### **Media and Design**

Digital Imaging and Printing, Types of Digital Images, Digital image Editing, Digital Printing  
Advertising Design, What is Media Planning, Campaign Design, Kinds of Campaign , Planning a  
Campaign Research & Data Collection

#### **Unit I:**

Orientation into visual art form. The Basics of traditional 2D animation, Introduction to the skill  
required thereof, beginning life drawing, Use of simple shapes. How to draw sketches with the  
help of basic shapes Learning to draw lines, circles, ovals, scribbles, zigzag (random) patterns etc.  
Background elements, trees, mountains, clouds, water bodies, meadows, perspective drawing  
Lights and shadows day night scenes, layers (concept and implementation) layout design and  
staging. An intro on how to make drawings for animation, shapes and forms, about 2D and 3D  
drawings, Caricaturing-fundamentals, Exaggeration, Attitude, Silhouettes, Boundary breaking  
exercises and warm-ups.

#### **Unit II:**

**HUMAN ANATOMY:** Structure of man, proportion of body parts, drawing from basic form, Line of  
action, balance Rhythm, turnings, twisting, drawing plane surfaces, torso, face, eyes, nose, ears,  
mouth, hand and feet.

**FEMALE ANATOMY:** Proportion and construction of female body, twisting of female body, chest,  
torso, face, parts of face, hands, hands in action, feet and gestures, curves, curls, rhythm and twist.

**CHILD ANATOMY:** Understanding child's figure, proportion and construction of child body, face,  
chubbiness, hand, feet and gestures.

**ANIMAL ANATOMY:** Animals from basic forms, understanding motion and grace of animals,  
turning animals to character, face, legs, tails, perspectives.

**CARTOON ANATOMY:** Understanding cartoon characters, drawing from basic shapes, line of  
action, distortion of proportion, cartoon faces, eyes, mouths, hairs, nose, hands, feet, gestures and  
poses.

#### **Reference Books:**

1. Internet and Web Technology, Soma Das Gupta, Khanna Publishing House

## Illustrations and Photo Editing

### UNIT – I

Introduction to Adobe Illustrator: Introduction to Adobe Illustrator, work area and workspaces and tools. Opening files, importing art work, viewing art work, rulers and grids, Drawing in Illustrator, drawing lines and shapes, pencil tool, pen tool, editing drawing, tracing, symbols, colouring, applying colours, swatches, adjusting colour and colour settings.

### UNIT – II

Painting with Illustrator, fills, strokes, brushes, transparency, blending, gradient, meshes and color blending. Selecting, transformation, scaling, grouping, reshaping, cutting, blending of object, creating 3D object, text and typing, special effects, filters, shadows, glow, feathering graphic styles.

### UNIT – III

Photoshop and its interface, Navigation and All tools, Working with basic selections, advanced selections-1(on the basis of channels, color range, extract, filter etc), Exercises on selections, Quick Masks, Layer Mask, Vector Mask, Layers & Layer Blending Modes, Play with Photoshop, Filter Gallery, Exercises, Bring some object and try to make it in computer, Make your own cartoon character.

Color Theory, Make a perfect cropping of some images using Photoshop, Prepare a cut-out of some images using Photoshop, Place nice background for those images, Prepare nice background using gradient tool, Scan various images, Color adjustment of those images (PHOTO RETOUCHING).

### UNIT – IV

Make Nature scene (winter) digital painting, Make Nature scene (summer) digital painting. Make digital painting (Use brush, pencil, smudge etc), Make something like modern art keeping in mind color combination, make a collage of Indian art and culture. Make a collage of wildlife animals, Make a portrait of celebrity (Digital painting).Convert a B&W image into color (Use variation), "Choose a theme (Music, Festivals, Sports, Dance) and Design 5-8 graphics on them.", Color Modes, Color Corrections, Advanced color correction techniques (levels, Curves, Hue, Saturation etc), Design that Ad from your own style. Design motifs tribe art, Make an animal character, "Plan a story of that character & Make its backgrounds in three/four frames", Make posters on nature/earth, Matte Painting- Composition, Creating images for the web: Exporting images from Photoshop.

### Reference Books:

1. Learning Illustrator, Ramesh Bangia, Khanna Publishing House

### **Web Applications Lab**

- Movie Editing Tools
- Customizing and Embedding, Multimedia Components in Web Pages.
- Web Scripting - Java Script.

### **Illustration and Photo-Editing-Lab**

- Script breakdown
- Storyboards
- Costume acquisition
- Sets and Properties design and sourcing
- Location recce and hire
- Location permissions and legal requirements, permissions from civic authorities
- Equipment requirements and bookings
- Travel and Transport
- Catering for crew
- Hospitality for out of town shoots

## Level5 (Semester II)

### Pre-Production

- Research, brainstorming & story concept creation: Intention / purpose & audience (what you intend to say & why)
- Story structure & character development: Narrative structure and character back story
- Sequence & shot analysis: Analysis and re-creation of timing and shot composition from professionally produced film/video productions
- Storyboards: Visual design (layout/composition, style, color, lighting etc.); Language of cinema (narrative structure, shot composition, spatial/directional continuity)
- Animatics / pre-viz: Timing and transitions Audio layering (music, ambient sound, narration)
- Budgeting and planning: Consideration of schedules, costs and other planning issues

### Audio Editing

#### UNIT – I

Sonic Sound Forge: Manipulating audio: Auto trim/crop, mute, DC offset, resample, reverse, smooth/enhance, Fade in/out, insert silence, bit depth converter etc, understanding various digital audio formats like .WAV, .AIFF, .MP3, swf, WMA etc, understand audio plug-in, importing and exporting into multiple audio file formats like MP3, real audio, QuickTime formats, etc.

Event tool: move, split, slip and trim multiple events, create fades, apply ASR (Attack/Sustain/Release). Understanding script editor window, Spectrum analysis tools, scrub tool etc, statistics tool (Max, RMS, DC offset, zero crossings), sampler tool etc, Audio editing: workflow, real time editing, event based editing, waveform volume and pan envelopes, Edit, record, encode and master digital audio, editing audio by drag and drop options, cross fading audio tracks, balancing sound levels, creating smooth fades etc.

#### UNIT – II

Understanding Multichannel audio recording, synchronize audio and video. Understanding regions and play lists, editing of fields, name markers, loops, and regions, Timing basis: absolute frames, measures and beats, Time and frames. Audio effects like: Equalizer, Volume, chorus, distortion, Delay/echo, pitch, bend/shift, reverb, vibrato, normalize etc Insert track markers, adding multiple tracks, adjusting track time, musical instrument file processing

#### Reference Books:

1. Audio & Video Systems, Bali & Bali, Khanna Publishing House

### **Video Editing**

- Adobe Premiere: Concept of non-linear editing,
- The basics of editing: Overview, Importing and Exporting: various audio, video and graphics in various formats, Edit, manipulate and arrange these elements in visual timeline, understand all Tools of toolbox for editing clips. Titling and superimposing.
- Panels: Tools panel, Project,
- Monitors: Source and program, Timeline, Audio meters,
- Misc. Tasks and functions: Titles, Transitions, speed and duration, Effects, Key frames, Types of edit, Opacity, trimming,
- Adding Special effects like: Star trek transporter effect, Blur part of an image, Ghost effect, Highlight part of an image etc.

#### **Reference Books:**

1. Audio & Video Systems, Bali & Bali, Khanna Publishing House

### **Communication Skill-II**

Communication Process:

Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precise writing/abstracting/summarizing; Style of technical communication Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions.

Structural and Functional Grammar:

Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults;

#### **Reference Books:**

1. Effective Communication Skills, Kulbhushan Kumar, Khanna Publishing House
2. Business Communications, Varinder Bhatia, Khanna Publishing House

### **Audio Editing Lab**

Using Editing Software – editing basics and implementation of various techniques used in non-linear editing. Mastering final edit line – audio levels, colour correction, audio mixing, mixed and un-mixed versions, importing and applying compatible graphics files. Understanding compression and its affects along with various methods.

### **Video Editing Lab**

1. Assisting Production department on shoot
2. Assisting Direction department on shoot
3. Assisting Art department on shoot
4. Assisting Camera department on shoot
5. Assisting Sound department on shoot



## Level 6 (Semester III)

### Principles of Animation and Techniques of Animation

#### UNIT – 1

Drawings with the help of basic shapes, Animal study, Human anatomy, Shading techniques, Live model study, Introduction- Importance of confidence, Difference between “looking at the drawing” and “seeing the drawing”, What is observation, Procedure- How to approach, Importance of Guideline- Line of action, Overcome the fear, Drawing for animation,

#### UNIT – 2

An Introduction on how to make drawings for animation, Shapes and forms, About 2d and 3d drawings, Caricaturing – fundamentals, Exaggeration, Attitude, Silhouettes, Boundary- breaking exercises and warm ups, gesture drawing, Line drawing and quick sketches, Drawing from observation, memory and imagination.

#### UNIT – 3

Drawing for Animation, Exercises and warm ups on pegging sheet, Quick Studies from real life, Sequential movement drawing, caricaturing the Action. Thumbnails, Drama and psychological effect,

Motion Studies, Drawing for motion,

#### UNIT – 4

The Body language, Re-defining the drawings, Introduction to animation production process, Basic Principles in animation, Squash and stretch, Anticipation, Staging, Straight ahead and pose to pose, Follow through and overlapping action, Slow in and slow out, Arcs, Secondary action, Timing, Exaggeration, Solid drawing, Appeal, Mass and weight, Character acting, Volume, Line of action, Path of action, Walk cycles-animal and human.

#### Reference Books:

1. Multimedia and Animation, V.K. Jain, Khanna Publishing House

## Basic of 3-D Modelling

### UNIT – I

Interface of 3DS max, Understanding the concept of four view ports, Aligning object in the each view port in X, Y, Z axis, Hot keys, User defined hot keys, Using the menus, Floating and docking. Command panel, customizing the interface, Using drag and drop feature, Introduction to different workspaces, "Geometry, Sub objects, Extruding, Welding, bridging etc, Recognizing the workspaces".

### UNIT – II

Introduction to standard and extended primitives. "Introduction to creating complex objects with Standard and extended primitives", Understanding the spline tools. Introduction to polytools. Using modifier stack, navigating the modifier stack, File navigation, Introduction to Connection (Hierarchy, Group, and Link).

### UNIT – III

Introduction to the 3d elevators and walk through, "Introduction to modifiers and modifier gizmos, Familiarity with Modifiers like Bend, edit poly, X form, wave, lathe symmetry etc

### UNIT – IV

Advanced 3DS Max, Modelling objects with lathe, loft, extrude etc, Creating 3D objects from 2D spline shapes, Organic and inorganic modelling

## Texture and Lighting

### Unit I:

Introduction to texturing, working with Diffuse, Opacity and Reflection, Basics of UV unwrapping, Creating texture maps, Bump and Displacement Mapping, Introduction to Video post, Introduction to standard lights.

### Reference Books:

1. Mastering Photoshop, WebTech Solutions, Khanna Publishing House

## Communication Skills III

**UNIT-I** Recognizing and Understanding Communication Styles: What is Communication, Passive Communication, Aggressive Communication, Passive-Aggressive Communication, Assertive Communication, Verbal and Non Verbal Communication, Barriers and Gateways to Communication.

**UNIT-II** Listening Skills: Types of Listening (theory /definition), Tips for Effective Listening Academic Listening- (lecturing), Listening to Talks and Presentations, Basics of Telephone Communication Writing Skills: Standard Business letter, Report writing, Email drafting and Etiquettes, Preparing Agenda and writing minutes for meetings, Making notes on Business conversations, Effective use of SMS, Case writing and Documentation

**UNIT-III** Soft Skills: Empathy (Understanding of someone else point of view), Intrapersonal skills, Interpersonal skills, Negotiation skills, Cultural Aspects of Communication.

**UNIT-IV** Group Communication: The Basics of Group Dynamics, Group Interaction and Communication, how to Be Effective in Groups, Handling Miscommunication, Handling Disagreements and Conflicts, Constructive Criticism

**Reference Books:**

1. Effective Communication Skills, Kulbhushan Kumar, Khanna Publishing House
2. Business Communications, Varinder Bhatia, Khanna Publishing House

**Digital Animation with FlashLab**

- Data management in postproduction.
- Setting up and preparing editing rooms and sound editing rooms
- Logging of rushes
- Assisting in rough cuts
- Assist in editing line-up
- Assist in synchronizing visuals and dialogue
- Assist in recording and matching sound effects

**Maya Lab**

- Navigate the Maya interface
- Access your objects in the Maya scene graph
- Use the Maya polygon and NURBS modeling tools
- Shade and apply texture maps to objects inside of Maya
- Union: Region belonging to one or both polygons
- Intersection: Region belonging to both polygons
- Difference: Region belonging to first but not second
- Polygon Texturing

## Level 6 (Semester IV)

### 3D Animation

#### Unit I: Body Mechanics

Students learn to use principles of traditional animation within the context of 3D animation by effectively applying them onto the character.

Part of good acting for animation is planning. The students learn to create or collect authentic visual references (both still and video) for animating body mechanics and understanding acting. Good poses are not only essential to create believable physicality but also it helps to clearly convey the character emotion for storytelling. They learn the importance of balance and weight, checking the silhouette all the time to make clearer poses.

They learn to act out body mechanics, learn the effect of physics (gravity/friction etc.) and artistic Presentation (composition, staging, silhouette etc.)

Students learn to convey Emotion not only in the facial expression but also in the body language.

#### Unit II: Facial Expression and Lip Sync

Foundation of good facial expression depends upon the reference and pre-planning. Detailed expression chart and voice recording is used as a starting point for any facial animation. Students learn to internalize the dialogue and they rehearse the sounds to match the shapes. They also need to draw out key poses before starting to pose in 3D.

A good animator needs more skillset than just to be able to animate how to create lip-synch. Students explore how to create the subtle facial expressions to suit the personality of the character and the accent style of the pre-recorded dialogue.

#### Unit III: Animation and the Body

Exploration of the diverse ways in which the human form takes shape in animated films, from highly photorealistic representations to stream-of-consciousness movement. Specific examples from 2D, 3D, stop-motion and hybrid work will be examined in order to shed light on the construction and animation of the body in contemporary film.

#### Reference Books:

1. Multimedia and Animation, V.K. Jain, Khanna Publishing House

## **Introduction to 3 D Motion Graphics & VFX**

### **UNIT – I**

Concepts for Broadcast animation for logos, channel IDs and montages, Multi-layer compositing, Special effects, Super imposition and titling, Exporting various file formats outputs as per the end user requirements.

### **UNIT – II**

Introduction to batch render & work group, Adding cameras & lights to a simple scene to make a complex compositing, Adding 2D back ground and elements into a 3D character layers, Creating object, material IDs for further adding special effects, Effects for digital video 2D layers and 3D layers for more effective outputs, adding particle effects into a scene.

### **UNIT – III**

Introduction to colour character and keying, "Editing the real time video with CG based scene and merging both of them to create a final output, Exporting various file format, output as per the end user requirements.

### **UNIT – IV**

Introduction to the batch rendering and work groups, Introduction to the concepts of editing in terms of compositing, Adding special effects in built in compositing software to make a simple shot into a perfect output.

### **UNIT – V**

Chroma keying, Luma key, Blue screen, Key frame text & layer animation & 3D particles, Effects etc. Color correction, Introduction to 3D compositing concepts i.e. Layers and masking, Rot scoping, Rig removal, Morphing.

### **Reference Books:**

1. Engineering AutoCAD, Pradeep Jain & A.P. Gautam, Khanna Publishing House

## **Introduction to Rendering**

### **Unit I:**

This unit teaches students about rendering concepts; formats and resolutions.

### **Unit II:**

This unit teaches students the advantages of different render software such as mental ray, v-ray, render man etc.

### **Unit III:**

This unit teaches students the benefits of layer based rendering. This process enhances the image quality without need of re-rendering the images again.

### **Unit IV:**

The rendered layers or passes need to be composited to get the final output.

### **Communication Skills IV**

Forms of non-verbal communication; interpreting body-language cues; Kinesics; Effective use of body language. The presentation and oral communication skill will be imparted through Group Discussion, Differences between group discussion and debate; Presentation Skills, Oral presentation and public speaking skills; The course also includes training and skill of Technology-based Communication, power-point presentation. Activities/tasks like role playing, group discussion, public speaking, extempore presentation and interviews will be conducted on regular basis.

Writing Skills: The activities will include: Writing Task: identifying the focus, generating ideas, outlining, etc. Paragraph Structure and Linking Sub-points in a Paragraph Cohesion and unity in a paragraph, Minding Punctuation and Proofreading, Summarising, Reviewing and Aspects of Creative Writing. Activities / tasks to be conducted like paragraph writing, essay writing, writing a review of a literary text, writing a summary of a literary text, comprehension and analysis of a literary text, preparing an advertisement.

### **Reference Books:**

1. Effective Communication Skills, Kulbhushan Kumar, Khanna Publishing House
2. Business Communications, Varinder Bhatia, Khanna Publishing House

### **3D Animation Lab**

- Assist in laying background music tracks
- Assist in mixing and mastering video
- Assist in creating titles and subtitles and basic animation sequences
- Understand and assist in the execution of modelling and rendering in 3D animation software.

### **3D Rendering Lab**

Introduction to Scene, Preparing the Scene, Basic Settings for Texturing, Create & Assign Textures, Light Setup, V-Ray Rendering Settings

- Rendering with V-Ray
- V-ray light setup
- V-ray rendering settings
- HDRI Illumination
- Fine-tuning shadows
- Final render setting

**Level 7 (Semester V)**  
**Digital Compositing**

- Introduction to Compositing software
- Principles of compositing
- Basic techniques
- Transparency
- Rotoscoping
- Wire Removal
- Chroma key
- Layer based compositing
- Compositing modes
- Animating layers

**3D Texturing**

**UNIT – I**

Introduction to basic material types & Procedurals. Study of concepts: Opacity, Smoothness, Specularity, and color, Working with Maya Surface Nodes-Blinn, Phong & Lambert, Working with Transparency, Reflection & Refraction, Bump & Displacement Maps, Introduction to unwrapping, Unwrapping the maps for various 3D characters.

**UNIT – II**

Working with 2D and 3D Texture, Introduction to the mapping and advanced texturing techniques, Shadow maps; ray traced shadows and radiosity, Creating photo real environments and textures, Basics of Utilities-Reverse, Stencil, Condition, Sampler Information.

**Basic of Accounts-I**

**Chapter 1:**

- Define the accounting process
- Describe the role of accountants
- Explain accounting concepts and principles
- Discuss the concept of the accounting equation
- Use the accounting equation to analyze basic transactions in terms of increases and decreases
- Reporting financial information on a balance sheet

**Chapter 2:**

- Determine how transactions change owner's equity in an accounting equation
- Reporting a changed accounting equation on a balance sheet



**Chapter 3:**

- Analyze transactions using T-accounts and using debits and credits
- Use debits and credits to record increase and decreases in accounts

**Chapter 4:**

- Record journal entries in a 5-column journal
- Define accounting terms related to journalizing transactions
- Prove and rule a five-column journal and prove cash

**Chapter 5:**

- Prepare a chart of accounts and opening accounts
- Post separate amounts from a journal to a general ledger
- Post column totals from a journal to a general ledger
- Make correcting entries

**Chapter 6:**

- Reconcile a bank statement and record bank service charges, dishonoured checks, and petty cash transactions

**Computer Graphics**

**UNIT-I** Graphics Primitives: Introduction to computer graphics, Basics of Graphics systems, Application areas of Computer Graphics, overview of graphics systems, video-display devices, and raster-scan systems, random scan systems, graphics monitors and workstations and input devices. Output Primitives: Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary fill and flood fill algorithms.

**UNIT-II** 2-D Geometrical Transforms: Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems. 2-D Viewing: The viewing pipeline, viewing coordinate reference frame, window to viewport coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

**UNIT-III** 3-D Object Representation: Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygonrendering methods.

**UNIT-IV** 3-D Geometric Transformations: Translation, rotation, scaling, reflection and shear transformations, composite transformations. 3-D Viewing: Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping

**Reference Books:**

1. Computer Graphics, Rishabh Anand, Khanna Publishing House
2. Computer Graphics, Gautam Roy, Khanna Publishing House

### **Digital Compositing Lab**

- 2D animation preproduction
- 2D character design
- 2D environment and background layout
- Motion graphic sequences

### **3D Texturing Lab**

1. Applying Texture for inorganic polygon models- I  
(Lamps, Mobile, Planet, Land with grass texture, rock, atmospheric objects system)
2. Applying Texture for organic polygon models – I (Cartoon, Semi cartoon)
3. Applying Texture for inorganic polygon models - II (Solar system, Car, Bike, Plane)
4. Applying Texture for organic polygon models - II (Human, Animal)
5. Applying Texture for organic Subdivision models – I (Cartoon, Semi cartoon)
6. Applying Texture for inorganic Subdivision models - II (Solar system, Car, Bike, Plane)
7. Applying texture for rendering final output with organic and inorganic objects

## **Level7 (SemesterVI)**

### **Muscle System**

#### **Unit I:**

Introduction to bone system/Joints and IK handles, creating bone system and maintaining naming conventions,

#### **Unit II:**

Skinning: types, import and export of skin weights, IK and FK basics, IK and FK switch, stretchy IK and FK,

#### **Unit III:**

Introduction to Deformers: attics, wrap, cluster, riggle, wire etc. Use of deformers in rigging process.

### **Rigging**

#### **UNIT –I**

Introduction to constraints and implementation to rigging, Maintaining proper hierarchy, grouping and creating controls, Rigging the characters, Introduction to Muscle system, Working with Muscle rigging, Introduction to automated rigging systems and methods.

#### **UNIT – II**

"Embedding small scripts in the hierarchy control system, to save time and facilitate handling", Advanced rigging, Vertex weighting techniques, Rigging solutions to Anatomical Problems, Using advanced rigging to archive natural articulation of character.

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY  
LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. VOC.**

**BANKING FINANCE SERVICES AND INSURANCE (BFSI)**

**Based on**

**AICTE MODEL CURRICULUM**

**(EFFECTIVE FROM THE SESSION: 2021-22)**

**B.Voc (BFSI) 1st & 2nd Year Course Structure in accordance with AICTE Model Curriculum  
With effect from Academic Session 2021-22**

SEMESTER - I											
Sl No	Subject Code	Subjects	Total Teaching / Training Hours	Evaluation Schemes						Total Marks	Credit
				Internal Evaluation				End Semester Ex			
				CT	TA	PS	Total	TE	PE		
1	BFSV 511	Basics of Economics and Markets	30	10	10	0	20	30	--	50	2
2	BFSV 512	Financial Accounting	30	10	10	0	20	30	--	50	2
3	BFSV 513	Principles and Practices of Banking	30	10	10	0	20	30	--	50	2
4	BFSV 514	Computer fundamentals & IT	30	10	10	0	20	30	--	50	2
5	BFSV 515	Business Communication	30	10	10	0	20	30	--	50	2
6	BFSP 511	Vocational Practical- I - Language Lab & Basic IT Practical	30	--	--	20	20	--	30	50	1
7	BFSP 512	Vocational Practical- II - Financial Accounting	30	--	--	20	20	--	30	50	1
8	BFST 511	Insurance Agent	400	Any One Training / 8 Weeks						150	12
	BFST 512	Business Correspondent / Business Facilitator									
	BFST 513	Debt Recovery Agent									
<b>Total</b>			<b>630</b>	--	--	--	--	--	--	<b>500</b>	<b>24</b>

SEMESTER - II											
Sl No	Subject Code	Subjects	Total Teaching / Training Hours	Evaluation Schemes						Total Marks	Credit
				Internal Evaluation				End Semester Ex			
				CT	TA	PS	Total	TE	PE		
1	BFSV 521	Marketing Management	30	10	10	0	20	30	--	50	2
2	BFSV 522	Human Resource Management	30	10	10	0	20	30	--	50	2
3	BFSV 523	Mutual Fund Operations	30	10	10	0	20	30	--	50	2
4	BFSV 524	Micro Finance Operations	30	10	10	0	20	30	--	50	2
5	BFSV 525	Indian Security Market	30	10	10	0	20	30	--	50	2
6	BFSP 521	Vocational Practical - III - Micro Finance Operations	30	--	--	20	20	--	30	50	1
7	BFSP 522	Vocational Practical - IV - Indian Security Market & Mutual Funds	30	--	--	20	20	--	30	50	1
8	BFST 521	Mutual Fund Agent	400	Any One Training / 8 Weeks						150	12
	BFST 522	Small and Medium Enterprise (SME) Officer									
<b>Total</b>			<b>630</b>	--	--	--	--	--	--	<b>500</b>	<b>24</b>

SEMESTER - III											
Sl No	Subject Code	Subjects	Total Teaching / Training Hours	Evaluation Schemes						Total Marks	Credit
				Internal Evaluation				End Semester Ex			
				CT	TA	PS	Total	TE	PE		
1	BFSV 631	Business Statistics	30	10	10	0	20	30	--	50	2
2	BFSV 632	Depository Operations	30	10	10	0	20	30	--	50	2
3	BFSV 633	Insurance Operations	30	10	10	0	20	30	--	50	2
4	BFSV 634	Financial Management	30	10	10	0	20	30	--	50	2
5	BKVH631	Human Values and Professional Ethics	30	10	10	0	20	30	--	50	2
6	BFSP 631	Vocational Practical V - Office Spreadsheets & Insurance Operations	30	--	--	20	20	--	30	50	1
7	BFSP 632	Vocational Practical VI –Depositories Operations	30	--	--	20	20	--	30	50	1
8	BFST 631	Financial Inclusion Officer	400	Any One Training / 8 Weeks						150	12
	BFST 632	Manager - Loan Approval									
	BFST 633	Loan Processing Officer									
Total			630	--	--	--	--	--	--	500	24

SEMESTER - IV											
Sl No	Subject Code	Subjects	Total Teaching / Training Hours	Evaluation Schemes						Total Marks	Credit
				Internal Evaluation				End Semester Ex			
				CT	TA	PS	Total	TE	PE		
1	BFSV 641	Business Environment	30	10	10	0	20	30	--	50	2
2	BFSV 642	Operations Management	30	10	10	0	20	30	--	50	2
3	BFSV 643	Entrepreneurship Development	30	10	10	0	20	30	--	50	2
4	BFSV 644	Quantitative Techniques	30	10	10	0	20	30	--	50	2
5	BKVE641	Environment and Ecology	30	10	10	0	20	30	--	50	2
6	BFSP 641	Vocational Practical VII –Case Studies and presentations on TQM Principles and use of Excel Solver for Quantitative Techniques	30	--	--	20	20	--	30	50	1
7	BFSP 642	Vocational Practical VIII - Case studies & presentations on Women Entrepreneurship and successful Entrepreneurs.	30	--	--	20	20	--	30	50	1
8	BFST 641	Operations Executive – Lending	400	Any One Training / 8 Weeks						150	12
	BFST 642	Process Executive - Financial Institutions									
	BFST 643	Accounts Executive									
Total			630	--	--	--	--	--	--	500	24

SEMESTER - V											
Sl No	Subject Code	Subjects	Total Teaching / Training Hours	Evaluation Schemes						Total Marks	Credit
				Internal Evaluation				End Semester Ex			
				CT	TA	PS	Total	TE	PE		
1	BFSV 751	Cost And Management Accounting	30	10	10	0	20	30	--	50	2
2	BFSV 752	Security Operations And Derivatives Market	30	10	10	0	20	30	--	50	2
3	BFSV 753	Tax Management And Investment Planning	30	10	10	0	20	30	--	50	2
4	BFSV 754	Retail And Business Banking Operations	30	10	10	0	20	30	--	50	2
5	BKVH751	Constitution of India, Law and Engineering	30	10	10	0	20	30	--	50	2
6	BFSP 751	Vocational Practical IX- Security Operations And Derivatives Market	30	--	--	20	20	--	30	50	1
7	BFSP 752	Vocational Practical X- Tax Management And Investment Planning	30	--	--	20	20	--	30	50	1
8	BFST 751	Research Officer - Financial Institutions	400	Any One Training / 8 Weeks						150	12
	BFST 752	Insolvency Associate									
Total			630	--	--	--	--	--	--	500	24

SEMESTER - VI											
Sl No	Subject Code	Subjects	Total Teaching / Training Hours	Evaluation Schemes						Total Marks	Credit
				Internal Evaluation				End Semester Ex			
				CT	TA	PS	Total	TE	PE		
1	BFSV 763	Financial Services	30	10	10	0	20	30	--	50	2
2	BFSV 764	Micro Small and Medium Enterprises	30	10	10	0	20	30	--	50	2
3	BKVH763	Indian Tradition, Culture and Society	30	10	10	0	20	30	--	50	2
4	BFSP 763	Major Project	180	-	-	-	-	-	150	150	6
5	BFST 763	Dealer - Financial Institutions	400	Any One Training / 8 Weeks						200	12
	BFST 764	CASA Sales Manager									
Total			670	--	--	--	--	--	--	500	24

## SEMESTER - I

### BFSV 511 - BASICS OF ECONOMICS AND MARKETS

#### COURSE OBJECTIVE:

- Understand the relative importance of Economics
- Know how the application of the principles of managerial economics can aid in achievement of business objectives
- Understand the basic structures of Markets and their importance.
- Be equipped with the tools necessary for today's business operation
- Understand and analyze the macro environment affecting the business decision making.

**Course Credit: 2**

**Hours: 30**

#### Unit I (8 Hours)

Basic Concepts and principles of economics: Definition, Nature and Scope of Economics-Micro Economics and Macro Economics, The Fundamentals of Economics, Utility, Wealth, Production, Fundamental Principles of Managerial Economics - Incremental Principle, Marginal Principle, Opportunity Cost Principle, Discounting Principle, Concept of Time Perspective, Equi-Marginal Principle

National Income; Concepts and various methods of its measurement, Inflation, types and causes, Business Cycle & its phases.

#### Unit II (8 Hours)

Demand and Supply Analysis: Theory of Demand, Types of Demand. Determinants of demand, Demand Function, Demand Schedule, Demand curve, Law of Demand, Exceptions to the law of Demand, Shifts in demand curve, Elasticity of Demand and its measurement. Price Elasticity, Income Elasticity, Arc Elasticity. Cross Elasticity and Advertising Elasticity. Uses of Elasticity of Demand for managerial decision making, Demand forecasting meaning,

Supply Analysis; Law of Supply, Supply Elasticity; Analysis and its uses for managerial decision making, Price of a Product under demand and supply forces.

#### Unit III (8 Hours)

Production and cost Analysis: Production concepts & analysis; Production function, Types of production function, Laws of production: Law of diminishing returns, Law of returns to scale.

Cost concept and analysis: Cost, Types of costs, and Cost output relationship in the short-run. Cost output relationship in the Long-run.

#### Unit IV (6Hours)

Market structures: Perfect Competition, features, determination of price under perfect competition. Monopoly: Feature, pricing under monopoly, Price Discrimination. Monopolistic: Features, pricing under monopolistic competition, product differentiation. Oligopoly: Features, kinked demand curve.

#### Books Recommended:

1. Managerial Economics: Geetika, Ghosh and Choudhury, McGraw-Hill Education 2nd Ed.
2. Managerial Economics: Concepts and Applications (SIE), THOMAS& MAURICE, McGraw-Hill Education, 9th Ed
3. Managerial Economics: H.L Ahuja, S.Chand, 8th Ed
4. Managerial Economics: D.N.Dwivedi, Vikas Publication, 7th Ed
5. Managerial Economics Theory and Applications: Dr.D.M.Mithani, Himalaya Publications, 7th Ed



## BSFV 512 - FINANCIAL ACCOUNTING

### COURSE OBJECTIVE:

- To provide a comprehensive treatment of accounting principles, technique and practices.
- To get the students acquainted with fundamental concepts and processes of accounting so that they are able to appreciate the nature of item presented in the annual accounts of an organization.
- To have a basic understanding of significant tools and techniques of financial analysis, which are useful in the interpretation of financial statements.

**Course Credit: 2**

**Hours: 30**

### UNIT I (6 Hours)

**Meaning and Scope of Accounting** : Overview of Accounting, Users of Accounting, Accounting Concepts Conventions, Book keeping and Accounting, Principles of Accounting, Basic Accounting terminologies, Accounting Equation

### UNIT II (9 Hours)

**Mechanics of Accounting** : Double entry system of Accounting, Journalizing of transactions; Ledger posting and Trial Balance ,Rectification of errors Preparation of final accounts, Profit & Loss Account, Profit & Loss Appropriation account and Balance Sheet.

### UNIT III (9 Hours)

**Analysis of financial statement:** Ratio Analysis- solvency ratios, Profitability ratios, activity ratios, liquidity ratios, Market capitalization ratios; Common Size Statement; Comparative Balance Sheet and Trend Analysis.

### UNIT IV (6 Hours)

**Cash Flow Statement:** Various cash and non-cash transactions, flow of cash preparation of Cash Flow Statement and its analysis.

### Books Recommended:

#### Text Books :

1. Maheshwari S.N & Maheshwari S K – A text book of Accounting for Management (Vikas, 10th Edition)
2. Essentials of Financial Accountng (based on IFRS), Bhattacharya (PHI,3<sup>rd</sup> Ed)
3. Ramachandran Kakani- Financial Accounting for Management ( TMH ,3<sup>rd</sup> Edition).
4. PC Tulsian- Financial Accounting (Pearson, 2016)
5. Dhamija - Financial Accounting for managers: (Prentice Hall, 2<sup>nd</sup> Edition).

## BFSV 513 - PRINCIPLES AND PRACTICES OF BANKING

### COURSE OBJECTIVE:

- The course encompasses the various principles and practices of the banking to make student aware of the current banking system.
- Student will understand various functions associated with banking.
- Practice and procedures relating to deposit and credit, documentation, monitoring and control.
- An insight into marketing of banking services and banking technology.

**Course Credit: 2**

**Hours: 30**

### UNIT-I (6Hours)

Definition of Bank – Basic functions of Banker, Banking System in India, Relationship between Banker and Customer, Special Types of Customers, Retail & Wholesale Banking, Commercial Banking- Functions, types, recent developments, Deposit Accounts – Savings Accounts, Current Accounts, Fixed Deposit Accounts, Opening and operation of Accounts, Nomination, KYC requirements, Pass Book, Minors.

### UNIT-II (8 Hours)

Liquid Assets– Cash in Hand, Cash with RBI & Cash with other Banks, Investment in securities, Advances – Secured and Unsecured Loans, Term Loans, Cash Credit, Overdraft, Discounting of Bills of Exchange, Modes of creating charge on Securities, Bills of Exchange & Promissory Notes, Cheque, Crossings, Payment and Collection of Cheque – duties and responsibilities of paying and collecting banker-protection available to paying and collecting banker under NI Act – endorsements – forged instruments – bouncing of cheques and their implications, Liabilities of Parties.

### UNIT-III (8 Hours)

Services rendered by Banks – Mandate and Power of attorney; Banker's lien – right of set off – garnishee order – Income tax attachment order etc, Safe Deposit Lockers, Opening of accounts for various types of customers – minors – joint account holders – HUF – firms – companies – trusts – societies – Govt. and public bodies, Importance of AML, Electronic Banking- Core Banking – Electronic products, NEFT, RTGS –Teller Machines at the Bank Counters – Cash dispensers – ATMs.

### UNIT-IV (8 Hours)

Principles of lending – various credit Products/ Facilities –Credit Appraisal Techniques – Approach to lending; – credit management – credit monitoring -NPA Management – Different types of documents; Documentation Procedures; Stamping of documents Securities – Different modes of charging – types of collaterals and their characteristics, Priority Sector Lending – sectors – targets – issues/problems – recent developments – Financial Inclusion Agriculture/SMEs/SHGs/SSI/Tiny Sector financing.

### Books Recommended:

1. IIBF, “Principles and Practices of Banking”, 2nd Edition, McMillian Publishers.
2. Paul and Suresh, “Management of Banking and Financial Services”, 2007, Pearson Education.
3. Sunderam and Varshney, “Banking Theory Law and Practices”, 2004, Sultan Chand and Sons.
4. Desai, Vasant, “Banks and institutional management”, 2008, Himalaya Publications.
5. Gurusamy, S., “Banking Theory: Law and Practice”, 2009, Tata McGraw Hill

## BFSV 514 - COMPUTER FUNDAMENTALS & IT

### COURSE OBJECTIVES

1. The course aims to provide knowledge about basic components of a computer and their significance.
2. To provide an orientation about the increasing role of management information system in managerial decision making to gain Competitive edge in all aspects of Business.
3. To understand various MIS operating in functional areas of an organization.
4. To create awareness in upcoming managers, of different types of information systems in an organization so as to enable the use of computer resources efficiently, for effective decision making.

**Course Credits: 2**

**Hours: 30**

### UNIT I (08 hours)

**Conceptual Framework-** Hardware: Basic Input devices - Keyboard, Mouse, Voice speech devices etc ; Hardware: Advanced Input devices - Scanner, MICR, OMR, Bar code reader, Digital camera etc ; Hardware: Output Devices - Visual Display Unit, Printers, Plotters, Speakers ; Hardware: Storage Devices - Magnetic storage devices, Optical storage devices, Flash Memory ; Introduction to Languages: compiler, Interpreter and Assembler ; Software: Types of software; Types, Classifications and Functions of Operating System ; Elements of GUI based operating system.

### UNIT II (08 hours)

**Communication Technology** - Network: Types of Computer Networks (LAN, WAN and MAN) ; Network Topologies: Linear, star, Ring, Mesh, Hybrid ; Internet: Architecture & Functioning ; Basic Internet Services-I: WWW, FTP, IP addresses, ISPs, URL ; Basic Internet Services-II: Web Browsers, Domain names ; Search engines ; E-mail application ; Netiquettes.

### UNIT III (8 hours)

**Information Systems** Concept of Data and Information ; Operations Support System (OSS): Transaction Processing System(TPS), Process Control System (PCS), Enterprise Collaboration System(ECS ) ; Management Support System(MSS): Management Information System(MIS), Decision Support System (DSS), Executive Information System(EIS) ; Artificial Intelligence (AI) ; Neural Networks ; Fuzzy Logical Control System ; Virtual Reality ; Expert System

### UNIT IV (06 hours)

**Information Systems for Business** - Enterprise Resource Planning (ERP); Customer Relationship Management (CRM) ; Security and Ethical Challenges Of IT ; Business Ethics, Technology Ethics ; Cyber Crime and Privacy Issues ; Cyber Laws and IT Act 2000.

### Books Recommended:

1. Fundamentals of Computers, V. Rajaraman, PHI Publication
2. Computer Fundamentals, P. K. Sinha, BPB Publication
3. Introduction to Computers with MS - Office 2007, Leon, TMH Publication

## BFSV 515 - BUSINESS COMMUNICATION

### COURSE OBJECTIVES:

1. To understand business communication strategies and principles for effective communication in domestic and international business situations.
2. To understand and appropriately apply modes of expression, i.e., descriptive, expository, narrative, scientific, and self-expressive, in written, visual, and oral communication.
3. To develop the ability to research and write a documented paper and/or to give an oral presentation.
4. To develop the ability to communicate via electronic mail, Internet, and other technologies for presenting business messages.
5. To understand and apply basic principles of critical thinking, problem solving, and technical proficiency in the development of exposition and argument.

**Course Credits: 2**

**Hours: 30**

### UNIT I (7 Hours)

**Introduction** - Role of communication ; Defining and classifying communication ; Purpose of communication ; Process of communication ; Characteristics & Importance of communication in management ; Communication structure in organization ; Barriers to communication.

### UNIT II (7 Hours)

**Oral communication** - What is oral Communication? ; Principles of successful oral communication; Reflection and Empathy: two sides of effective oral communication; Effective listening – non – verbal communication; Written communication: Purpose of writing; Principles of effective writing – approaching the writing process systematically; The 3X3 writing process for business communication: Pre writing – Writing – Revising.

### UNIT III (6 Hours)

**Business Letters and Reports** - Introduction to business letters – writing routine and persuasive letters; Writing Memos; Objectives, Purpose and Types of Report Writing; What is a Presentation - Presentation skills; Elements of presentation – designing a presentation

### UNIT IV (10 Hours)

**Employment & Group Communication** - Writing CVs ; Group discussions ; Interview skills ; Impact of Technological Advancement on Business Communication networks : Intranet, Internet, e mails and SMS ; Teleconferencing & Video Conferencing; Meetings: Planning, Objectives, Participants ; Timing & Venue of Meetings ; Media Management: Press Release, Press Conference, Media Interviews ; Seminars, Workshops & Conferences.

### Books Recommended:

1. Bovee & Thill – Business Communication Essentials A Skill – Based Approach to Vital Business English. Pearson.
2. Kulbhushan Kumar & R.S. Salaria, Effective Communication Skills, Khanna Publishing House, Delhi
3. Bisen & Priya – Business Communication (New Age International Publication)
4. Kalkar, Suryavanshi, Sengupta- Business Communication (Orient Blackswan)
5. Varinder Bhatia, Business Communications, Khanna Publishing House
6. Business Communication : Skill, Concepts And Applications – P D Chaturvedi, MukeshChaturvedi Pearson Education.
7. AshaKaul, Business Communication, Prentice Hall of India.

**BFSP 511 - VOCATIONAL PRACTICAL- I – LANGUAGE LAB & BASIC IT PRACTICAL**  
**Course Credit: 1** **Hours- 30**

1. Learning of proper English language Pronunciation
2. Learning of proper English language Phonetics
3. Learning Basics of Office Documentation
4. Learning basic Office Power Point Presentation

**BFSP 512 - VOCATIONAL PRACTICAL- II - FINANCIAL ACCOUNTING**  
**Course Credit: 1** **Hours- 30**

1. Accounting Package Tally: Creation of company; Heads sub heads; Groups and Sub Groups; Feeding of transactions; related aspects of maintaining of accounts in Tally.
2. Presentation of Indian Accounting standards
3. PPT presentation of audited Balance sheet of listed companies on stock exchange.

**TRAINING MODULES**

BFST 511	Insurance Agent	<b>Contact Hours : 400</b>	<b>Any One Training / 8 Weeks</b>	<b>Credit :12</b>
BFST 512	Business Correspondent / Business Facilitator			
BFST 513	Debt Recovery Agent			

## SEMESTER – II

### BFSV 521 - MARKETING MANAGEMENT

#### COURSE OBJECTIVES:

1. Assess market opportunities by analyzing customers, competitors, collaborators, context, and the strengths and weaknesses of a company.
2. Understand consumers' requirements and their behaviors.
3. Develop effective marketing strategies to achieve organizational objectives.
4. Developing an aptitude for Salesmen ship and Understanding the customer buying Behavior.

**Course Credit: 2**

**Hours: 30**

#### Unit 1(6 hours)

**Introduction:** Nature and scope of marketing, Evolution, Various marketing orientations, Core concepts of marketing, customer value and the value delivery process. Understanding Consumer Behavior: Buying motives, factors influencing buying behavior, buying habits, stages in consumer buying decision process, types of consumer buying decisions,

#### Unit 2 (6 hours)

**Market segmentation, Targeting and Positioning:** Meaning, Factors influencing segmentation, Market Aggregation, Basis for segmentation, Targeting: Meaning, Basis for identifying target customers, Target Market Strategies. Positioning: Meaning, product differentiation strategies, tasks involved in positioning.

#### Unit 3 (8 hours)

##### Marketing Mix:

**Product:** Product Mix, New Product development, levels of product, types of product, Product life cycle, Branding and packaging.

**Distribution:** Concept, importance, different types of distribution channels, Factors affecting channel choice

**Price:** Meaning, objective, factors influencing pricing, methods of pricing.

**Promotion:** Promotional mix, tools, objectives,

#### Unit 4 (10 hours)

**Salesmanship and Qualities of Salesman:** Product knowledge, Customer knowledge: Buying Motives and Selling Points. Scientific Selling; Approach and Presentation: Methods of Approaching a Customer; Presentation Process and Styles; Presentation planning. Objection Handling: Types of objections; Handling customer objections. Closing Sales and Follow up: Methods of closing sale; executing sales order; Follow-up; Sales Promotion Schemes: Sampling; Coupon; Price Off; Premium Plan; Consumer Contests and Sweeps Takes; POP Displays; Demonstration; Trade Fairs and Exhibitions; Sales Promotion Techniques and Sales Force.

##### Books Recommended:

1. Marketing Management: A South Asian Perspective - Kotler, Keller, Kevin 15/e, Pearson Education, 2016.
2. Marketing Management - Ramaswamy V. S. & Namakumar S, 5/e, McGrawHill Education Publishers, 2015.
3. Marketing Management - Tapan Panda, 5/e, Excel Publication, 2007.
4. Fundamentals of Marketing Management - Etzel M. J, B J Walker & William J. Stanton, 14/e, McGrawHill Education Publishers, 2015.
5. Marketing: Asian Edition Paul Bainies, Chris Fill Kelly Page third edition, Oxford.

## **BFSV 522 - HUMAN RESOURCE MANAGEMENT**

### **COURSE OBJECTIVE:**

1. The students will learn the basic concepts and frameworks of Human Resource Management (HRM)
2. Student will understand the role that HRM has to play in effective business administration.
3. Student will learn the techniques of Compensation management to manage human resource.

**Course Credit: 2**

**Hours: 30**

### **UNIT I (6 Hours)**

Elements of HRM: Evolution of HRM, Meaning, Nature and Scope, HRM functions and objectives, Difference between HRM and HRD, Concept of Strategic HRM

### **UNIT II (8 Hours)**

Human Resource Planning and Employee Hiring: Nature of Job Analysis, Human Resource Planning, Process, factors influencing HRP, Employee hiring- Nature of Recruitment, Sources of recruitment, Employee selection, process of employee selection, recent trends in recruitment.

### **UNIT III (8 Hours)**

Employee Training & Development: Nature and importance of Training, methods and types of training, career planning, promotion, transfer, demotion and separation, Performance Appraisal: Meaning and types of appraisal, Job Evaluation: Meaning and methods of job evaluation.

### **UNIT IV (8 Hours)**

Compensation Management and Employee Relations: Introduction to compensation management, Components of employee and executive compensation, Factors affecting employee compensation, recent trends in compensations management, Meaning and nature of employee relation and industrial relations.

### **Books Recommended:**

1. V.S.P.Rao, Human Resource Management (Text and Cases) Himalaya Publications, Thirteenth Edition.
2. Durai Praveen, Human Resource Management Pearson Publication, 2nd Edition.
3. Gary Dessler and Biju Varkkey Human Resource Management, Person Publication, 2013, 14th Edition.
4. Seema Sanghi, Human Resource Management, Vikas Publications, 2014, 5th Edition.
5. K. Aswathappa, Human Resource Management, McGraw Hill Education, 2013, 7th Edition.

## BSFV 523 - MUTUAL FUNDS OPERATIONS

### COURSE OBJECTIVES:

1. The course aims at a comprehensive understanding of the advanced level of mutual fund.
2. The nature of risks involved in the matter of investment in the market.
3. The investor and distributors process of Mutual funds will also be explained.

**Course Credit: 2**

**Hours: 30**

### UNIT - I ( 6 Hours)

Introduction: Definition of Mutual Fund, Structure and constituents of Mutual Funds;, Organization of Mutual Fund, Types of Mutual Funds, Advantages and Limitations of Mutual Funds. Mutual fund products: Kinds of Mutual Fund - Fixed Income category, Govt. Bonds, Corporate Bonds, Debt Instruments, Indexed Funds, Balanced Funds, Money Market Funds..

### UNIT - II ( 9 Hours)

Applicable NAV and cut- off time: Defining NAV, components of NAV, Calculation of NAV. Factors to be considers for NAV calculation. Purchase, redemption and systematic transactions: Mutual Fund fees, Mutual Fund Purchase, (direct Purchase, and Purchase through broker). Redemption Procedure or Buy Back, Systematic Investment in Mutual Funds.

### UNIT - III ( 9 Hours)

Investor and distributor processes and payouts: Individual mutual funds distributors, Employees of organization engaged in sales and distribution of mutual funds. Traditional and alternate distribution channels. Handling Monetary Transactions: Mutual fund fees, entry and exit load, risk measurement, Kinds of return. Valuation Process.

### UNIT - IV ( 6 Hours)

Handling Non- monetary Transactions: Valuation, accounting, legalities and Taxation aspect of mutual funds and their distribution. SEBI's Role and Relevant Regulations: Role of SEBI, SEBI advertising code for mutual funds, Norms regarding return representation of mutual funds.

### Books Recommended:

1. Khan, M.Y., "Financial Services", Tata McGraw Hill, New Delhi.
2. Gurusamy, S., "Financial Services and System", 2004, Vijay Nicole Imprints Pvt. Ltd., Chennai.
3. Bhalla, V.K. "Management of Financial Services", Anmol Publications Pvt. Ltd., New Delhi.
4. Pathak, Bharati, "Indian Financial System", Pearson Education, New Delhi.
5. Avadhani, V.A., "Capital Market Management", Himalaya Publishing House
6. Bhole, L.M., "Financial Institutions and Market", Tata McGraw Hill
7. Mobius Mark, " Mutual Funds: An Introduction to the Core Concepts", Wiley.com
8. Shashikant, Abraham and Bhargava, "Understanding Mutual Funds", McGraw Hill Publications.
9. Tripathy, "Mutual funds in India", Excel Books



## BFSV 524 - MICRO FINANCE OPERATIONS

### COURSE OBJECTIVES

1. To gain conceptual framework of Micro Finance
2. To gain insight of MFI Industry
3. To have understanding structural framework of MFI
4. To acquaint the students of role played by MFI in financial inclusion of society.

**Course Credit: 2**

**Hours: 30**

### UNIT I (6 Hours)

Concept and scope of Microfinance, History of Micro Finance ,Evolution of Microfinance in India, Importance of Micro Finance in financial inclusion, Ethical issues related to Micro- Finance. Financial Inclusion and Exclusion.

### UNIT II (9 Hours)

Micro finance lending models: association or group model, community banking model, co-operative model, Grameen model, intermediary model, individual banking model, mixed / multiple models, business facilitator, business correspondent model.

### UNIT III (9 Hours)

Role played Micro Finance Institutions in economic development; Groups organized by MFI's in India: Joint Liability group, Self Help Group, Grameen Model Bank, Rural Cooperative. What are Self Help Groups and their importance, Difference between self-help group and Joint Liability group.

### UNIT IV (6 Hours)

Legal frame work/forms for MFI'S in India; societies registration act, 1860; Indian trusts act, 1882, not-for-profit companies registered under section 25 of companies act, 1956, non-banking finance companies, Nidhi companies. Role of Management information system in micro finance, Customers served by micro finance and products offered through Micro Finance.

### Books Recommended:

1. Financial Inclusion -Sameer Kochchar
2. Financial Inclusion – RBI notes
3. Financing of SMEs- G Gopala Krishnan Murthy

## BFSV 525 - INDIAN SECURITY MARKET

### COURSE OBJECTIVES:

1. To gain conceptual framework of Indian Security Market
2. To gain insight of various intermediaries involved in Security Market
3. To have understanding structural framework of regulatory mechanism of Security Market
4. To acquaint the students about portfolio construction

**Course Credit- 2**

**Hours- 30**

### UNIT I (6 Hours)

Introduction to Indian Security Market, Definition & Characteristics of security: Primary and Secondary markets. Investment Vs Speculation. Different Types of Financial Instruments Concepts of risk and return. Regulators of Indian Security market.( SEBI).NSE & BSE.

### UNIT – II (9 Hours)

Security markets as allocators of capital: Capital Market and Money Market; Issues in Indian security market, Role of stock brokers, Portfolio Managers, Merchant Bankers, Underwriters and Credit Rating Agencies.

### UNIT – III (9 Hours)

Efficient Market Hypothesis– concept, implication, Technical analysis – assumption tools, Fundamental analysis – economic, industry, company analysis. Valuation of equity, risk and return measurement.

### UNIT – IV (6 Hours)

Portfolio construction – selection of portfolio, approaches, portfolio selection models – Markowitz portfolio model, Sharpe index model, CAPM, Arbitrage Pricing Theory, Multi Index Model; Portfolio performance evaluation.

### Books Recommended:

1. Sharpe, William F., Gordon J. Alexander and Jeffrey V. Bailey, Investments (Prentice Hall).
2. Fabozzi, Frank Investment Management (Prentice Hall).
3. Haugen, Robert A., The Inefficient Stock Market (Prentice Hall).
4. Taggart, Robert A., Quantitative Analysis for Investment Management (Prentice Hall).
5. Richard Brealey and Steward Myers, Principles of Corporate Finance, (McGraw Hill).
6. Dimson, E. (ed.), Stock Market Anomalies (Cambridge : Cambridge University Press).
7. Khan, M. Y., Financial Services, Tata McGraw Hill Publishing Company, New Delhi.
8. Singh, Preeti, Investment Management, Himalaya Publishing House, New Delhi.
9. Avadhani, V. A., Investment Management, Himalaya Publishing House, New Delhi.

## BFSP 521 - VOCATIONAL PRACTICAL –III - MICRO FINANCE OPERATIONS

**Course Credit: 1**

**Hours- 30**

- Loan Application/Loan Prospecting/Loan Approvals/Loan Documentation
- Loan Disbursements/Loan Collections & Recoveries
- Communication and Interviewing Skills/Borrower Profiling Skill, Counseling and Financial Advising Skills/Time Management Skill
- Sales & Marketing Skills/Cross Selling Skills, Understanding the role & importance of back office operations in an MFI
- PPT Presentation on different Micro Finance companies and their products by student groups.

## BFSP 522 - VOCATIONAL PRACTICAL –IV - INDIAN SECURTY MARKET& MUTUAL FUNDS

**Course Credit: 1**

**Hours- 30**

- Fundamental and Technical Analysis of select companies listed on NSE.
- Study of Stock Exchanges in India.
- Hypothetical portfolio construction of through various investment instruments available in market.
- Working on NAV and Cutoff time of Mutual Funds
- Handling non-monetary transactions with respect to Mutual Funds

### TRAINING MODULE

BFST 521	Mutual Fund Agent	<b>Contact Hours : 400</b>	<b>Any One Training / 8 Weeks</b>	<b>Credit :12</b>
BFST 522	Small and Medium Enterprise (SME) Officer			

## SEMESTER III

### BFSV 631 - BUSINESS STATISTICS

#### COURSE OBJECTIVES

1. Understand the different basic concept / fundamentals of business statistics.
2. Understand the practical application of various concepts.
3. Understand the importance of measures of Descriptive statistics their implication on Business performance.
4. Understand the concept of Probability and its usage in various business applications.
5. Understanding Decision making environment and applying the Concept of Business Analytics.

**Course Credit: 2**

**Hours: 30**

#### Unit I (5 Hours)

**Introduction to Statistics** – Origin, meaning and purpose of statistics. Scope and limitations of statistics. Collection and presentation of data. Sources and methods of data collection. Principles of data classification, Tabulation of data.

#### Unit II (9 Hours)

**Frequency Distributions and Measures of central tendency** – Frequency Distribution and graphic representation of frequency distributions. Measures of Central Tendency – Arithmetic, Geometric and Harmonic mean. Merits and demerits of Mean, Mode and Median, Measures of Variations, Skeweness and Kurtosis

#### Unit III (10Hours)

**Correlation and Regression Analysis:** Introduction to Correlation and Regression. Correlation Analysis – Significance and types of correlation, Methods of Correlation analysis – Scatter diagram, Karl Pearson's coefficient, Rank correlation and method of least squares, standard Error of estimates, Simple linear regression model and coefficients of regression, Index Numbers.

#### Unit IV (6 Hours)

Time series Analysis – Introduction, Utility of time series analysis, Components and analysis of time series data. Measuring Trends of time series, semi-average, moving averages and method of least squares.

#### Books Recommended:

1. N.G Das: Statistical Methods (Volume I): Tata McGraw-Hill.
2. A.M Goon, M.K Gupta & B, Dasgupta: Basic Statistics : World Press
3. G. C. Beri : Statistics for Management: Tata McGraw- Hill
4. Bharat Jhunjunwala: Business Statistics, S. Chand Publishing
5. V.K. Kapoor & S.C. Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

## BFSV 632 - DEPOSITORY OPERATIONS

### COURSE OBJECTIVES:

1. Understand the need, importance, roles & responsibilities of depositories,
2. Understand the need depository participants,
3. Understand different types of securities handled by them and corporate actions handled by them.

**Course Credit- 2**

**Hours-30**

### Unit I (6 Hours)

Introduction to the Indian Capital Market: Capital Market, Regulatory Environment, Regulators; Introduction to depository: Need for a depository system, what is depository, Legal Framework, Functions of a depository; Depository Participants, clearing Corporation, Issues and registrar and transfer agents.

### Unit II (9 Hours)

Functions of Depository participant- Account opening; Introduction, types of account, beneficial owner account, clearing member account, closure account, freezing accounts, changes in client details; Transmission and Nomination: Transmission of securities, Nomination of Securities; Dematerialization: Introduction, International Securities identification number(ISIN), dematerialization process, Rematerialisation, Destatementization, Restatementization; Trading and settlement: Introduction, Settlement of off- Market Transactions, settlement of market transactions, procedure for subscription and redemption of mutual funds

### Unit III ( 9 Hours)

Special Services- Pledge and hypothecation: Introduction, procedure of pledge /hypothecation, Recording of Non disposable undertaking in the depository, Corporate Actions: Concept of corporate actions, procedure for corporate actions; Public Issues and tender offer: Introduction, public issue procedure, tender offer

### Unit IV ( 6 Hours)

Debt Instruments & Government Securities: Introduction, certificate deposits (CD), Commercial Paper (CP), Government Securities; Basic Services Demat Account (BSDA): Introduction to basic service, Demat account, Introduction to redressal of complaints through scores.

### Books Recommended:

1. Depository Operations, NISM Publications, 2020 Ed

## BFSV 633 - INSURANCE OPERATIONS

### COURSE OBJECTIVE:

1. To develop the understanding of general and life insurance
2. To gain an insight in terms of features, principles, practices and operations of Insurance
3. To identify various types of products offered under different types of Insurances
4. To understand the concept of Risk and Reassurance

**Course Credit: 2**

**Hours: 30**

### Unit I (6 Hours)

Principles and Practice of Insurance-Introduction, Types of Insurance-General and Life, Basic principles of General and Life Insurance, Insurance contracts-Regulations on investments, insurance funds with respect to shareholders funds and policy holders funds-costing and pricing of insurance products

### Unit II (8 Hours)

General insurance products, underwriting concepts, standard conditions and warranties with respect to Fire, Marine, Motor, Engineering and Miscellaneous products

### Unit III (8Hours)

Life insurance products, premium plans, social security schemes, pension policies, group insurance schemes and financial gerontology of superannuating policies-Principles of Actuarial valuation

### Unit IV (8 Hours)

Risk Management and Reinsurance: Economics of insurance; Managerial aspects of risk management; Reinsurance-legal principles and methods of reinsurance, Management of insurance companies

### Books Recommended:

1. Agarwal, OP, Banking & Insurance, Himalaya Publishing House, Mumbai
2. George E Rejda, Principles of Risk Management & Insurance, Pearson Education, New Delhi
3. Balachandran S., General Insurance, Insurance Institute of India, Mumbai
4. Arthur C., William Jr., Michael Smith, Peter Young, Risk Management and Insurance, Tata McGraw Hill Publishing Company, New Delhi
5. Tripathy Nalini Prava & Prabir Pal, Insurance Theory & Practice, Prentice Hall of India Pvt. Ltd., New Delhi

## **BFSV 634 - FINANCIAL MANAGEMENT**

### **COURSE OBJECTIVE:**

1. To gain an understanding on the use of basic business financial management concepts and tools of analysis such as valuation.
2. To gain an insight into various types of financing available to a firm.
3. To have an understanding of various factors considered in designing the capital structure.
4. To acquaint the students about key areas related to investment and Working Capital Management.
5. To gain an insight into various techniques of dividend and retention ratio.

**Course Credit: 2**

**Hours: 30**

### **Unit I (6 Hours)**

Concept of Finance: Finance & its scope Financial Decisions, Sources of Finance Time Value of Money ,Profit maximization vs. Wealth maximization, Concept of Risk and Return.

### **Unit II (9 Hours)**

Investment Decision: Concept of Opportunity Cost, Cost of Debenture, Preference and Equity capital, Composite Cost of Capital, Capital Budgeting Techniques risk analysis and capital rationing.

### **Unit III (9 Hours)**

Policy matters in Financial Management: Dividend policy decision, Capital structures. EBIT EPS Analysis

### **Unit IV (6 Hours)**

Working Capital Management: Concepts of Working Capital and its types, Determinants of Working Capital, Working Capital Financing; Inventory management, cash management, receivable management.

### **Books Recommended:**

#### **Text Books:**

1. Khan and Jain - Financial Management (Tata McGraw Hill, 7th Ed.)
2. Pandey I M - Financial Management (Vikas, 11th Ed.)
3. William HakkaBettner Carcello- Financial and Management Accounting(TMh-16th Ed.)
4. Sheeba kapil-Fundamental of financial management (Wiley,2015 )
5. Prasanna Chandra - Fundamentals ofFinancial Management (TMH, 9th Ed.)
6. Bark Demazo Thampy- Financial Management (Pearson,2nd Ed.)
7. R P Rustagi - Financial Management (Galgotia, 2000, 2nd revised ed.)

## **BKVH631 - HUMAN VALUES AND PROFESSIONAL ETHICS**

### **COURSE OBJECTIVES:**

- 1) To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
- 2) To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence.
- 3) To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

**Course Credit: 2**

**Hours: 30**

### **UNIT 1(6 Hours)**

#### **Course Introduction - Value Education**

Understanding the need, basic guidelines, content and process for Value Education. Self-Exploration: What is it? Its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Right understanding, Relationship and Physical Facilities: the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels

### **UNIT 2 (6 Hours)**

#### **Understanding Harmony in the Human Being**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I' ; Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail ; Programs to ensure Sanyam and Swasthya - Practice Exercises and Case Studies will be taken up in Practice Sessions.

### **UNIT 3 (6 Hours)**

#### **Understanding Harmony in the Family and Society**

Understanding Harmony in the family – the basic unit of human interaction; Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship; Understanding the meaning of Vishwas; Difference between intention and competence; Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals; Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha )- from family to world family! - Practice Exercises and Case Studies will be taken up in Practice Sessions.

### **UNIT 4 (6 Hours)**

#### **Understanding Harmony in the Nature and Existence**

Understanding the harmony in the Nature; Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature; Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions.



## **UNIT 5 (6 Hours)**

### **Holistic Understanding of Harmony on Professional Ethics**

Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people-friendly and ecofriendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems; Case studies of typical holistic technologies, management models and production systems; Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers , b) At the level of society: as mutually enriching institutions and organizations

### **Books Recommended:**

1. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2
2. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi, 2010

## **BFSP 631 – VOCATIONAL PRACTICAL V: OFFICE SPREAD SHEETS & INSURANCE OPERATIONS**

**Course Credit: 1**

**Hours: 30**

1. Learning about Office spreadsheet for database management
2. Insurance forms filling process
3. Learning about various Life and Non-Life Insurance products
4. Learning about Risk and Reassurance in the Insurance sector

## **BFSP 632 – VOCATIONAL PRACTICAL VI: DEPOSITORIES OPERATIONS**

**Course Credit: 1**

**Hours: 30**

1. Understanding and presentation about Functions of Depository participant.
2. Understanding and presentation about Special Services in Depositories domain.
3. Understanding and presentation about Debt Instruments & Government Securities.

### **TRAINING MODULES**

<b>BFST 631</b>	<b>Financial Inclusion Officer</b>	<b>Training Hours :400</b>	<b>Any One Training / 8 Weeks</b>	<b>Credit :12</b>
<b>BFST 632</b>	<b>Manager - Loan Approval</b>			
<b>BFST 633</b>	<b>Loan Processing Officer</b>			

**SEMESTER IV**  
**BFSV 641 - BUSINESS ENVIRONMENT**

**COURSE OBJECTIVE:**

1. To develop knowledge of the environment in which business operates
2. To provide the students with the background of various environmental factors that has major repercussions on business
3. To watch and update the changes that occurs constantly in various environment
4. To identify the impact of technology in the environment

**Course Credit: 2**

**Hours: 30**

**UNIT – I (6 Hours)**

Business Environment: Scope of business, characteristics of business, Meaning and Characteristics of Business Environment, Scope and Significance, Factors affecting environment and its impact on business, Internal and external environment, micro environment and macro environment

**UNIT – II (8 Hours)**

Economic, Political & Legal Environment: Economic system, economic planning, Economic policies- new industrial policy, FEMA, Monetary and fiscal policies, Competition Act-2002, Functions of state, economic roles of government, government and legal environment

**UNIT – III (8 Hours)**

Technological, Social and Cultural Environment: Concept and significance of technological environment, Innovation, technological leadership and followership, sources of technological dynamics, impact of technology on globalization, transfer of technology, time lags in technology introduction, Status of technology in India; Management of technology; Features and Impact of technology, Impact of foreign culture on Business, Traditional Values and its Impact, Social responsibility of business, Social Audit

**UNIT – IV (8 Hours)**

The contribution of Public sector enterprises in India, Privatization and disinvestment in India, Foreign Direct Investment in India, its impact on Indian economy, Globalization – Meaning, Nature and stages of Globalization, features of Globalization, MNC'S, LPG Model

**Books Recommended:**

- 1) Environmental Studies, M.P. Poonia & S.C. Sharma, Khanna Publishing House, Delhi
- 2) Business Environment: Test and Cases, PAUL, McGraw Hill Education, 3 rd Ed.
- 3) Business Environment ---Francis Cherunilam, Himalaya Publishing House
- 4) V. Neelamegam – Business Environment (Vrinda Publications , 2nd Edition)
- 5) Shaikh & Saleem - Business Environment (Pearson, 2nd Edition)

## BFSV 642 – OPERATIONS MANAGEMENT

### **COURSE OBJECTIVE:**

1. This course will help the students to digest the basic features of the subject apart from a handful of theories, laws, hypothesis included in the course, before the students stamp their feet on the corporate sector.
2. To understand the role of Operations in overall Business Strategy of the firm.
3. To understand the trends and challenges of Operations Management in the current business environment
4. Quality concepts help students to understand how to improve their work, work culture and organization.

**Course Credit: 2**

**Hours: 30**

### **Unit I (6 Hours)**

Operations Management, Difference between Production and Operations Management, Productivity, Productivity measurement, Factors affecting Productivity, Difference between product and service, Characteristics of service, Classification of service, factors affecting service operations.

### **Unit II (8 Hours)**

Production Technology – Types of Manufacturing processes, Business Process Reengineering, New Product Development(Process), Product Design, Factors affecting Product Design, Design feasibility analysis, Product reliability analysis, Congruent Engineering, Quality Function Deployment, Robust Design and Taguchi Method, Design Failure Mode & Effect Analysis, Benchmarking.

### **Unit III (8 Hours)**

Introduction to Quality, Evolution of Quality Management, Concepts of Product and Service Quality, Dimensions of Quality, Deming's 14 principles, Juran's Quality Trilogy, Crosby's Quality Philosophy, Quality Cost. SERVQUAL model of measuring service quality Gap, Total Quality Management (TQM), Latest trend in Production and operation – Lean manufacturing, Agile manufacturing

### **Unit IV (8 Hours)**

JIT Quality Philosophy, PDCA Cycle - KAIZEN, Quality Circles, Introduction to Process Quality, Graphical and statistical techniques for Process Quality Improvement, 7QC Tools and Advancement, Quality Improvement. Total Productive Maintenance (TPM), Pillars of TPM, 5S Philosophy, Six sigma, ISO 9001 and QS 9000, Quality audit.

### **Books Recommended:**

- 1) Mahadevan : Operations Management: Theory and Practice (PEARSON)
- 2) Ashwathapa K: Production and Operation Management (Himalya Publication)
- 3) Adam Jr Everett E. R J – Production and Operations Management (Prentice-Hall, 2000, 5th Edition)

## BFSV 643 - ENTREPRENEURSHIP DEVELOPMENT

### COURSE OBJECTIVES

1. The purpose of this course is to expose the student to the basic concepts of Entrepreneurship
2. Students will be exposed to the functions of entrepreneurs, and problems faced by them in the real world.
3. To provide insights to students in converting an Idea to an opportunity
4. Familiarizing the students on Developing a Business Plan and to provide basic understanding of Launching a New Venture

**Credits: 2**

**Hours: 30**

### Unit 1 (8 Hours)

#### Introduction to Entrepreneurship

Meaning and Definition of Entrepreneur; Types and Functions of Entrepreneur; Concept Entrepreneurship and its development; Corporate entrepreneurship; Concepts of Intrapreneurship , Family Business, Women Entrepreneurship, Social and Rural Entrepreneurship.

### Unit 2 (8 Hours)

#### From Idea to Opportunity

Idea Generation: Sources and Methods; Identification and Classification of Ideas; Individual creativity: Idea to Business Opportunity; Opportunity Assessment; Challenges of New Venture Start-Up; Venture capital; Angel Investing; Crowd funding

### Unit 3 (8 Hours)

#### Developing a Business Plan

Environmental Scanning and SWOT analysis; Business Plan as an entrepreneurial tool; Business Planning Process; Elements of business planning; Preparation of project plan; Components of an ideal business plan – Market plan, Financial plan and Operational plan; Feasibility Analysis: Economic and financial analysis; Market and Technological Feasibility.

### Unit 4 (6 Hours)

#### New Venture

Launching a New Venture; Steps involved in Launching a Business; Various Forms of Business Ownership; Registration of Business Units; Start-Up to going IPO; Revival, Exit and End to a Venture.

### Books Recommended:

1. Roy :Entrepreneurship, OUP
2. Entrepreneurship 10th Ed (Indian Edition) 2016 by Robert Hisrich Michael Peters Dean Shepherd, McGraw Hill
3. Khanka, S.S.; Entrepreneurial Development; S. Chand and Co.
4. Kumar, Arya; Entrepreneurship; Pearson Education.
5. 5.Desai, Vasant; Dynamics of Entrepreneurial Development and Management; Himalaya Publishing
6. Blundel, R. and Lockett, N.; Exploring Entrepreneurship Practices and Perspectives; Oxford Publications.
7. Dollinger, M. J.; Entrepreneurship: New Venture Creation; PHI Learning.

## **BFSV 644 -QUANTITATIVE TECHNIQUES**

### **COURSE OBJECTIVES:**

1. To make better decisions in complex scenarios by the application of a set of advanced analytical methods.
2. It couples theories, results and theorems of mathematics, statistics and probability with its own theories and algorithms for problem solving.
3. It helps in making complex decision with the help of advanced techniques

**Course Credit: 2**

**Hours: 30**

### **Unit I (8 Hours)**

Introduction to Operation Research: - Meaning, Evolution, approaches, techniques and scopes of operations research, managerial application of Operation Research. Linear programming:- Introduction, meaning characteristics, graphical approaches and its utility , simplex method, dual linear programming

### **Unit II (7 Hours)**

Transportation & Assignment Problem: - The general structure of the problem, basic feasible solution by N W method, Low cost method, VAM, optimal solution and testing of optimal solution by stepping stone method, Assignment problem, structure variation in assignment problem.

### **Unit III (8 Hours)**

Sequencing Problem: Johnsons Algorithm for n Jobs and Two machines, n Jobs and Three Machines, Two jobs and m - Machines Problems.

Replacement Problem: Replacement of assets that deteriorate with time, replacement of assets which fail suddenly.

### **Unit IV (7 Hours)**

Decision-making under certainty, uncertainty and risk situations, Decision tree approach and its applications. Concept of Business Analytics- Meaning, types and application of Business Analytics.

### **Books Recommended:**

1. Vohra - Quantitative Techniques in Management (Tata McGraw-Hill, 2nd)
2. Kapoor V.K- Operations Research: Quantitative Techniques for Management ( Sultan Chand, New Delhi)

## BKVE641- ENVIRONMENT & ECOLOGY

### COURSE OBJECTIVES:

1. To develop awareness of the ecology and environment around us in general
2. To understand the availability and usage of various natural resources
3. To understand and reduce various reasons of various types of Pollutions
4. To understand and work towards betterment in terms of climate changes

**Credit : 2**

**Hours : 30**

### UNIT 1 (8 Hours)

**Introduction** - Definition, Scope & Importance of Ecology ; Need For Public Awareness ; Environment definition ; Concept of Balanced ecosystem ; Human activities - Food, Shelter, Economic and social Security ; Effects of human activities on environment : Agriculture, Housing, Industry, Mining and Transportation activities ; Basics of Environmental Impact Assessment and Sustainable Development.

### UNIT 2 (8 Hours)

**Natural Resource** - Water Resources· Availability and Quality aspects ; Water borne diseases and Water Induced diseases ; Fluoride problem in drinking water ; Mineral Resources, Forest Wealth ; Material cycles: Carbon, Nitrogen and Sulphur Cycles ; Energy - Different types of energy, Electro-magnetic radiation ; Conventional and Non-Conventional sources - Hydro Electric, Fossil Fuel based, Nuclear, Solar, Biomass and Bio gas ; Hydrogen as an alternative future source of Energy.

### Unit 3 (7 Hours)

**Environmental Pollution and their effects** - Water pollution, Land pollution, Noise pollution, Air Pollution ; Public Health aspects ; Solid waste management ; E-waste management

### Unit 4 (7 Hours)

**Current Environmental Issues and Protection** - Population Growth ; Climate Change and Global warming- Effects ; Urbanization and Automobile Pollution ; Acid Rain and Ozone Layer depletion; Role of Government ; Legal aspects ; Initiatives by Non-Governmental organizations (NGO) ; Environmental Education ; Women Education

### Books Recommended:

1. Environmental Studies -Benny Joseph- Tata McgrawHill
2. Environmental Studies- Or. D.L. Manjunath, Pearson Education
3. Environmental studies - R, Rajagopalan -Oxford Publication
4. Text book of Environmental Science & Technology- M. Anji Reddy- BS Publication.

**BFSP 641 – VOCATIONAL PRACTICAL VII: CASE STUDIES AND PRESENTATIONS ON TQM AND USE OF EXCEL SOLVER FOR QUANTITATIVE TECHNIQUES**

**Credit: 1**

**Hours: 30**

1. To understand the TQM concept and discuss various case study
2. To make presentation on various latest TQM concepts
3. To understand the Excel Solver tool in order to decipher complex Quantitative Problems

**BFSP 642 – VOCATIONAL PRACTICAL VIII: CASE STUDIES AND PRESENTATIONS ON WOMEN ENTREPRENEURSHIP AND SUCCESSFUL ENTREPRENEURS**

**Credit: 1**

**Hours: 30**

1. To discuss various case studies based upon Women entrepreneurship
2. To discuss various case studies based upon various successful entrepreneurs in India.
3. To make presentation on various opportunities available for Women to enter Entrepreneurship domain.

**TRAINING MODULES**

<b>BFST 641</b>	<b>Operations Executive – Lending</b>	<b>Contact Hours :400</b>	<b>Any One Training / 8 Weeks</b>	<b>Credit : 12</b>
<b>BFST 642</b>	<b>Process Executive - Financial Institutions</b>			
<b>BFST 643</b>	<b>Accounts Executive</b>			



## SEMESTER V

### BFSV 751- COST AND MANAGEMENT ACCOUNTING

#### **COURSE OBJECTIVE:**

1. The objective of this course is to expose the students to the applied aspect of accounting and making them familiar with the techniques of using Accounting information for decision making.
2. Having been introduced to these techniques and having acquired the ability to understand accounting language, the students should be in a position to make effective use of accounting information in resolving the problems, which they may face as managers.

**Course Credit- 2**

**Hours -30**

#### **Unit I (6 hours)**

Introduction: Accounting for Management, Role of Cost in decision making, Comparison of Management Accounting and Cost Accounting, types of cost, cost concepts, Elements of cost - Materials, Labour and overheads ,preparation of Cost Sheet, Methods of Costing, Reconciliation of Cost and Financial Accounting.

#### **Unit II (9 Hours)**

Marginal Costing: Marginal Costing versus Absorption Costing, Cost-Volume-Profit Analysis and P/V Ratio Analysis and their implications, Concept and uses of Contribution & Breakeven Point and their analysis for various types of decision-making like single product pricing, multi product pricing, replacement, sales etc.

#### **Unit III (9 Hours)**

Budgeting: Concept of Budget, Budgeting and Budgetary Control, Types of Budget, Static and Flexible Budgeting, Preparation of Cash Budget, Sales Budget, Production Budget, Materials Budget, Capital Expenditure Budget and Master Budget, Advantages and Limitations of Budgetary Control.

#### **Unit IV (6 hours)**

Standard Costing: Concept of standard costs, establishing various cost standards, calculation of Material Variance, Labor Variance, and Overhead Variance, and its applications and implications. Activity Based Costing.

#### **Books Recommended :**

1. Pandey I M - Management Accounting (Vikas, 2004, 3rd Ed.)
2. Vij-Management Accounting (Excel Books)
3. Balakrishnan \_ Managerial Accounting (Wiley Dreamtech)
4. Alex –Cost Accounting (Pearson)
5. Khan and Jain - Management Accounting (Tata McGraw-Hill, 2000)
6. Sinha- Accounting and Costing for Management (Excel Books)
7. Horngren et al - Introduction to Management Accounting (Prentice hall, 2002, 12th edition)

## BFSV 752- SECURITY OPERATIONS AND DERIVATIVES MARKET

### COURSE OBJECTIVES

1. To know the role played by the various participants in the Indian securities market.
2. Understand the trade life cycle, the steps and participants involved in the trade life cycle.
3. Know the various functions of the Front Office, Middle Office and Back Office in a Securities Broking Firm.
4. Understand how the risks are managed in a securities broking firm, the clearing and settlement process.
5. Understand the various procedures for redress of investor grievances.
6. Understand the derivative markets and its various types.

**Course Credit: 2**

**Hours- 30**

### UNIT I (6 Hours)

Market Participants in the Securities Market: Investors, Issuers, intermediaries, regulators; Introduction to security operations: Trade life cycle, front office operations, back office operations; Risk Management, Compliance and regulatory frame work, core settlement guarantee fund.

### UNIT II (9 Hours)

Clearing Process; Introduction, Role of the clearing agency, clearing banks and their functions, Clearing members/Custodians, Depositories and Depository Participants, Clearing Process; Settlement Process; Introduction, Determination of settlement obligations, settlement of funds, Settlement of securities, Corporate actions adjustment, Auction of securities; Investors Grievances, Investor Protection fund, Arbitration.

### UNIT III (9 Hours)

Overview of Derivatives; Concept and feature of Derivatives; Types of Derivatives: OTC and Exchange Traded, Classification of derivatives; Forward, Futures, Options and Swaps; Participants in derivatives market; Meaning and characteristics of Forward Contracts, advantages and limitations of forward contracts; Meaning and Characteristics of future contract, Terminology in future contract; Advantages and limitations of future contract; Distinction between forward and future contract.

### UNIT IV (6 Hours)

Meaning of Options and its Characteristics, Terminology in option contract, Call option and Put option, Parties to option contract, Intrinsic and Time Value of option, Moneyness of the options, Advantages and limitations of options, Options Greeks; Financial swaps: Interest rate and Currency swaps.

### Books Recommended:

1. NISM publications
2. Thomas Susan, Derivatives Market in India; Tata McGraw Hill,2005
3. Financial Derivatives: Theory, Concepts and practices by S.L. Gupta, PHI, 2013.
4. Financial Derivatives by S.S.S Kumar, PHI, 6th Ed.
5. Options, Futures and other Derivatives, John C. Hull; Prentice Hall of India; New Delhi, 10th ed.

## **BFSV 753 - TAX MANAGEMNT AND INVESTMENT PLANNING**

### **COURSE OBJECTIVE**

1. To enable the students to understand the importance of tax management and various methods available for tax planning.
2. This course also aims to acquaint students with the importance and methods for Investment Planning.

**Course Credit- 2**

**Hours- 30**

### **UNIT I (6 Hours)**

Tax Management: Introduction to tax management, features and scope of tax management. Differentiate between tax planning, tax avoidance and tax evasion. Tax Planning: Meaning, need, scope, objectives and methods of tax planning. Definition, Cannons of Taxation Person, Assesse, Income, Previous Year, Assessment Year, Income Tax Important Dates and Forms. Residential Status & Tax Incidence: Individual Income Exempted from Tax.

### **UNIT II (14 Hours)**

Tax planning for Five Heads of Income: Income from salary, house property, profits and gains from business or profession, capital gains and income from other sources.

### **UNIT III (6 Hours)**

Calculation of Taxable Income ,Tax Calculation including Surcharge and Marginal relief, Deductions , Rebates, Reliefs, Set Off & Carry Forward of Losses –Inter – sources & Inter – head Set Off. Provisions relating to collection and recovery of tax- Refund of tax.TDS.

### **UNIT IV (4 Hours)**

Investment Planning: Meaning and process of investment planning. Investment Planning objectives – Retirement planning, tax saving, capital growth, liquidity and safety. Investment Instruments for Personal Financial Planning: Tax saving instruments (all investments covered u/s 80C like, Provident fund, PPF, ELSS, NPS etc)

### **Books Recommended:**

1. Mehrotra, H. C. and Goyal, S. P., 'Income Tax: Tax Planning and Management' Sahitya Bhawan Publications.
2. Singhania V.K., 'Direct Taxes: Law and Practice', Taxmann Publications
3. Ahuja, G. and Gupta, R., 'Practical Approach to Direct and Indirect Taxes: Containing Income Tax and GST', Wolters Kulwer

## BFSV 754 - RETAIL & BUSINESS BANKING OPERATIONS

### COURSE OBJECTIVES:

1. To give an insight of operational aspects of retail banking products
2. To develop suitable strategies to broaden the retail client base
3. To identify important retail asset products along with the trends in retail banking
4. To get an overview of Business Banking

**Course Credit :2**

**Hours: 30 Hrs**

### Unit-I (6 Hours)

Concept of Retail Banking-Distinction between Retail and Corporate/Wholesale Banking; Retail Products Overview: Customer requirements, products development process, Liabilities and Assets Products, Approval process for retail loans, credit scoring

### Unit-II (8 Hours)

Important Retail asset products: Home loans, Auto/vehicle loans, Personal loans, Educational loans -Study of these products in terms of Eligibility, Purpose, Amounts, Margin, Security, Disbursement, Moratorium, Prepayment issues, Repayments/Collection; Credit/Debit Cards-Eligibility, Purpose, Amounts, Margin, Security, Process of using the cards, Billing Cycle, Credit Points; Other products/Remittances/Funds Transfer

### Unit-III (8 Hours)

Retail Strategies: Tie-up with institutions for retail loans; Delivery Channels-Branch, Extension counters, ATMs, POS, Internet Banking, M-Banking; Selling process in retail products; Customer Relationship Management-Role and impact of customer relationship management, stages in CRM process; Technology for retail banking, Trends in Retailing-New products like insurance, Demat services, online/phone banking, property services, investment advisory/wealth management, Reverse Mortgage-Growth of e-banking, Cross selling opportunities

### Unit-IV (8 Hours)

Business Banking- Definition & characteristics, Accounts & deposits, Lending products, Other services – treasury, trade & forex, SME: Definition & characteristics, RBI & GOI directives, Role of Bankers, Challenges in SME Business

### Books Recommended:

1. Agarwal, O.P., Fundamentals of Retail Banking, Himalaya Publishing House, Mumbai.
2. Jha, SM, Banking Marketing, Himalaya Publishing House, Mumbai
3. Khan, MY, Indian Financial System, Tata McGraw Hill Publishing Company Ltd., New Delhi
4. Uppal, RK, & Bishnupriya N, Modern Banking in India, New Century Publications, New Delhi
5. Uppal, RK, Banking Services and IT, New Century Publications, New Delhi
6. Guruswamy, S., Banking in the New Millennium, New Century Publications, New Delhi
7. Indian Institute of Banking & Finance, Retail Banking, Mumbai

## BFSV 755 - INDIAN CONSTITUTION

**Course Credit: 2**

**Hours: 30**

**UNIT I:** Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, **Features:** Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy

**UNIT II: Structure of the Indian Union:** Federalism, Centre- State relationship, **President:** Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

**UNIT III: Governor:** Role and Position, CM and Council of ministers, **State Secretariat:** Organization, Structure and Functions

**UNIT IV: District's Administration head:** Role and Importance, **Municipalities:** Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, **Pacnhayati raj:** Introduction, **PRI:** Zila Panchayat, Elected officials and their roles, **CEO Zila Panchayat:** Position and role, **Block level:** Organizational Hierarchy (Different departments), **Village level:** Role of Elected and Appointed officials, Importance of grass root democracy

### References

1. 'Indian Polity' by Laxmikanth
2. 'Indian Administration' by Subhash Kashyap
3. 'Indian Constitution' by D.D.Basu
4. 'Indian Administration' by Avasti and Avasti

**BFSP 751 - VOCATIONAL PRACTICAL IX  
SECURITY OPERATIONS AND DERIVATIVES MARKET**

**Course Credit – 1**

**Hours- 30**

1. Practice Sessions of Virtual Trading on online platform available on web.
2. PPT presentation on Derivative segments of Indian Security Market.

**BFSP 752 - VOCATIONAL PRACTICAL X  
TAX MANAGEMNT AND INVESTMENT PLANNING**

**Course Credit – 1**

**Hours- 30**

1. PPT presentation on different ITR to be filled by individuals as per their income source and filing procedure.
2. PPT presentation on various investment avenues available for tax planning for individuals.

**VOCATIONAL TRAINING**

<b>BFST 751</b>	<b>Research Officer - Financial Institutions</b>	<b>Training Hours : 400</b>	<b>Any One Training /8 Weeks</b>	<b>Credit : 12</b>
<b>BFST 752</b>	<b>Insolvency Associate</b>			

## SEMESTER VI

### BFSV 763 - FINANCIAL SERVICES

#### **COURSE OBJECTIVE:**

1. The objective of the course is to understand role of Financial Services in Business organizations
2. To give an insight into the strategic, regulatory, operating and managerial issues concerning select financial services.
3. The course will examine the present status and developments that are taking place in the financial services sector and developing an integrated knowledge of the functional areas of financial services industry.

**Course Credit- 2**

**Hours- 30**

#### **UNIT I (6 Hours)**

Financial Services: Financial services – Meaning, need for financial services, various types of financial service: Fund based and Non-Fund Based.

Merchant Banking: Introduction, concept of merchant banking, financial system in India, development of merchant banks and importance of merchant bankers. Latest guidelines of SEBI w.r.t. Merchant bankers, Issue Management - pre-issue and post-issue management activities performed by merchant banks.

#### **UNIT II (9 Hours)**

Credit rating: The concept and objective of credit rating, various credit rating agencies in India, Credit Rating Agencies –Importance, Issue, Difference in credit rating, Rating methodology and benchmarks.

Venture Capital: Concepts and characteristics of venture capital, venture capital in India, guidelines for venture capital.

#### **UNIT III (9 Hours)**

Leasing: Concept and development of leasing, business, difference between leasing & hire purchase, types of leasing business, advantages to lessor and lessee.;

Debt Securitization: Meaning, Features, Scope and process of securitization.

#### **UNIT IV (6 Hours)**

Factoring: Meaning and characteristics of factoring, Types of Factoring contract, Advantages and limitations of factoring agreement; Bill discounting, distinction between bills discounting and factoring; Forfeiting.

Plastic Money: Concept and different forms of plastic money – credit and debit cards, pros and cons. Credit process followed by credit card organizations. Factors affecting utilization of plastic money in India.

#### **Books Recommended:**

1. M Y Khan 'Financial Services' Tata McGraw-Hill.
2. S Gurusamy ' Financial Services & System' Thomson Publications
3. V. A. Avdhani ' Financial Services in India' Himalaya Publications
4. Gordon & Natarajan ' Financial Markets & Services' Himalaya Publications
5. Vasant Desai 'Financial Markets & Financial Services' Himalaya Publications

## **BFSV 764 - MICRO SMALL & MEDIUM ENTREPRISES (MSME)**

### **Course Objectives**

1. To make student understand meaning of MSME's.
2. To understand the basic structure and forms of MSME's
3. To understand the institutional framework and MSME's financing
4. To understand the various development and rehabilitation aspects of MSME's

**Course Credit- 2**

**Hours- 30**

### **UNIT I (9 Hours)**

Evolution, Definition of SMEs, Characteristics, Advantage of MSME & Its role & Significance in economic development, Role in Economic Development., Needs of SMEs. Forms of Organizations; Proprietary, Partnership, HUFs, LLP, Company etc., Establishing SMEs: Environmental Scanning, Market Assessment, Technology, Selection of Site, etc., - Organizational Structures – Rules & Regulations - MSMEs: Policy, Regulatory and Legal Framework; Policy Framework for SMEs - Regulatory Framework - Laws and Regulations for SMEs - SME Development Bill, 2005 – LLP Act, Registration of SME Unit – Procedure, CIBIL, CERSAI, D & B report, MIRA report.

### **UNIT II (6 Hours)**

Institutional Framework & MSME Financing; Institutions - Central Government - SSI Board, SIDO, SISI, PPDCs, RTCs, CFTI, NISIET, NIESBUD, NSIC - State Government: Directorate of Industries, DICs, SFCs, SIDC / SIIC, SSIDC - Financial Institutions & Banks; SIDBI, Commercial Banks, RRBs and Co-op. Banks etc., - Enterprise Perspective - Banker's Perspective.

### **UNIT III (9 Hours)**

Sources of finance and methods of financing SMEs, relevance of quasi capital and own money in business - Venture Capital, Hybrid Capital, special financial products for SMEs, Assessment of Term Finance / Working Capital for SMEs - Credit Risk Management of SMEs - Appraisal, assessment, collaterals, documentation, inspection, follow-up and monitoring and review, Credit Scoring models, Standing and liquidity assessment, Credit pricing of SMEs, Micro Enterprise finance, P.S. guidelines related to MSME, Mudra Bank, Factoring.

### **UNIT IV (6 Hours)**

Business Development Service Providers - Role & Responsibilities -Improving Competitiveness of SMEs through Enhancing Productivity - Market Promotion and Development - technological Development in SMEs - Environmental Impact Assessment, Modernization issues (technological and quality up gradation), Role and Functions of Credit Guarantee Trust for small industries (CGTSI), CGTMSE, PMEGP, TUFS, NEF. Rehabilitation; Sickness-symptoms, warning signals, diagnosis and prescriptions, rehabilitation, restructuring, holding on operations, work out, NPA management, recovery options, legal aspects / options, securitization and exit options / alternatives.

### **Books Recommended:**

1. Micro, Small and Medium Enterprises in India- Indian Institute of Banking and Finance Publications (ed.2017)
2. E-books of Ministry of Micro small & medium enterprises.



## BKVH 761 - Indian Tradition, Culture and Society

Course Credit: 2

Hours: 30

### UNIT I

**Introduction to traditional knowledge:** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge through indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge through formal knowledge

### UNIT II

**Protection of traditional knowledge:** the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

### UNIT III

**Traditional knowledge and intellectual property:** Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

### UNIT IV

**Traditional knowledge in different sectors:** Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

### References:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam
4. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata

## BSFP 763 – MAJOR PROJECT

**Course Credit: 6**

**Hours: 150**

1. On the basis of learning in the Bachelor of Vocational, a project to be taken up by the student strengthening his/ her vocational skills
2. PPT presentation of the Project
3. Hard copy is to be submitted to the institute.

## VOCATIONAL TRAINING

<b>BFST 763</b>	<b>Dealer - Financial Institutions</b>	<b>Training Hours : 400</b>	<b>Any One Training / 8 Weeks</b>	<b>Credit : 12</b>
<b>BFST 764</b>	<b>CASA Sales Manager</b>			

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY  
LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc.**

**Electronics Manufacturing Services (EM)  
Branch Code: 111**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

**EVALUATION SCHEME**  
**Electronics Manufacturing Services**

NSFQ Level 5 SEMESTER- I											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BEMV511	Electronic Measurement and Instrumentation –I	30	10	5	5	20	30		50	2
2	BEMV512	Identification of Components, Tools, SOP & Work Instructions-I	30	10	5	5	20	30		50	2
3	BEMV513	Tools, Equipment & Safety Measures –I	30	10	5	5	20	30		50	2
4	BEMV514	Soldering & De-Soldering of Components –I	30	10	5	5	20	30		50	2
6	BEMP511	Identification of Components, Tools, Equipment and its working –Lab	30				20		30	50	1
7	BEMP512	Electronic Measurement and Instrumentation -I –Lab	30				20		30	50	1
8	BEMP513	Language Lab	30				20		30	50	2
8	BEMT511	Embedded Software Engineer (ELE/Q1501)					Any one Training 400 hrs/ 8 weeks			150	12
	BEMT512	Security System Service Engineer (ELE/Q4610)									
	BEMT513	Systems Analyst (ELE/Q8701)									
	BEMV511	Embedded Software Engineer (ELE/Q1501)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 5 SEMESTER- II											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BEMV521	Electronic Measurement and Instrumentation –II	30	10	5	5	20	30		50	2
2	BEMV522	Identification of Components, Tools, SOP & Work Instructions-II	30	10	5	5	20	30		50	2
3	BEMV523	Tools, Equipment & Safety Measures –II	30	10	5	5	20	30		50	2
4	BEMV524	Soldering & De-Soldering of Components & Emergency actions II	30	10	5	5	20	30		50	2
5	BEMP521	Soldering & De-Soldering of Components-Lab	30				20		30	50	1
6	BEMP522	Electronic Measurement and Instrumentation -II (Lab)	30				20		30	50	1
7	BEMP523	IT Tool Lab	30				20		30	50	2
8	BEMT521	Smartphone Assembly Inspector (ELE/Q4001)					Any one Training 400 hrs/ 8 weeks			150	12
	BEMT522	Business Development Executive (ELE/Q1101)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 6 SEMESTER- III											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BEMV631	Fault analysis & Repairs	30	10	5	5	20	30		50	2
2	BEMV632	Good Manufacturing Concept & Practices – I	30	10	5	5	20	30		50	2
3	BEMV633	Electronics Devices Circuit –I	30	10	5	5	20	30		50	2
4	BEMV634	Electronics System Packaging and Manufacturing	30	10	5	5	20	30		50	2
5	BKVV631	Human Values and Professional Ethics	30	10	5	5	20	30		50	2
6	BEMP631	Electronics Devices Circuit –I Lab	30				20		30	50	1
7	BEMP632	Fault analysis & Repairs – Lab +	30				20		30	50	1
8	BEMT631	Field Engineer RACW (ELE/Q3105)					Any one Training 400 hrs/ 8 weeks			150	12
	BEMT632	Security System Service Engineer (ELE/Q4610)									
	BEMT633	Pre-Sales Solar Technical Support Engineer (ELE/Q5602)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 6 SEMESTER- IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BEMV641	Good Manufacturing Concepts Practices–II	30	10	5	5	20	30		50	2
2	BEMV642	Manufacturing & Quality Norms	30	10	5	5	20	30		50	2
3	BEMV643	Good Manufacturing Concepts & Practices–III	30	10	5	5	20	30		50	2
4	BEMV644	Electronics Devices Circuit –II	30	10	5	5	20	30		50	2
5	BKVE641	Environment and Ecology	30	10	5	5	20	30		50	2
6	BEMP641	Electronics Devices Circuit –II Lab	30				20		30	50	1
7	BEMP642	Manufacturing Practices	30				20		30	50	1
8	BEMT641	Purchase Executive (ELE/Q5701)					Any one Training 400 hrs/ 8 week			150	12
	BEMT642	Quality Engineer (ELE/Q7901)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BEMV751	Valuation & Storage	30	10	5	5	20	30		50	2
2	BEMV752	Shelf Life, Ware House Operations Management & Material Transactions	30	10	5	5	20	30		50	2
3	BEMV753	Industrial Electronics Product Design	30	10	5	5	20	30		50	2
4	BEMV754	Pre-Production Activities	30	10	5	5	20	30		50	2
5	BKVH751	Constitution of India, Law and Engineering	30	10	5	5	20	30		50	2
6	BEMP751	Pre-Production Activities-Lab	30				20		30	50	1
7	BEMP752	Valuation & Storage-Lab	30				20		30	50	1
8	BEMT751	Product Engineer (ELE/Q4201)					Any one Training 400 hrs/ 8 weeks			150	12
	BEMT752	Incoming QC Technician (ELE/Q4401)									
	BEMT753	Assembly Supervisor (ELE/Q6305)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BEMV761	Entrepreneurship/Accounting/Management	30	10	5	5	20	30		50	2
2	BEMV762	Trouble shooting and Maintenance of Electronics Equipment	30	10	5	5	20	30		50	2
3	BKVH761	Indian Tradition, Culture and Society	30	10	5	5	20	30		50	2
4	BEMP761	Major Project	180						150	150	6
5	BEMT761	FPGA Design Engineer (ELE/Q8201)					Any one Training 400 hrs/ 8 weeks			200	12
	BEMT762	Sales Executive-Consumer Electronics (ELE/Q3201)									
<b>Total</b>			<b>670</b>							<b>500</b>	<b>24</b>

## Detailed Curriculum Level 5 (Semester I)

### Electronic Measurements and Instrumentation-I

#### Unit, dimensions and standards

Scientific notations and metric prefixes, SI electrical units, SI temperature scales, Other unit systems, dimension and standards. Measurement Errors: Gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, Measurement error combination, basics of statistical analysis. PMMC instrument, galvanometer, DC ammeter, DC voltmeter, series ohm meter Transistor voltmeter circuits, AC electronic voltmeter, current measurement with electronic instruments, probes Digital voltmeter systems, digital multi-meters, digital frequency meter system.

#### Electromagnetic Effects

Permanent magnets and Electromagnets, their construction and uses, Polarities of an electromagnet and rules for finding them, Faraday's Laws of Electromagnetic Induction, Dynamically induced e.m.f., its magnitude and induction, inductance and its unit. Mutually induced e.m.f., its magnitude and direction, Energy stored in an inductance. Force acting on a current carrying conductor in magnetic field, its magnitude and direction, Principles and construction of dynamo.

#### A.C Circuits

Generation of A.C. voltage, its generation and wave shape. Cycle, frequency, peak value R.M.S. value, form factor, crest factor, Phase difference, power and power factor, A.C. Series Circuits with (i) resistance and inductance (ii) resistance and capacitance and (iii) resistance inductance and capacitance, Q factor of R.L.C. series circuits.

### Identification of Components, Tools, SOP & Work Instructions-I

#### 1. Main components & modules/ sub-assemblies of electronic equipment

- Control Panel (System Controller)
- Keypads
- Door and Window Contacts
- Motion Detectors
- Glass Break Detection
- Smoke Detectors
- Heat Sensors
- Carbon Monoxide Detectors
- Water Detectors (or Water Bug)
- Temperature Sensors
- Capacitance switches / control push buttons & rotary switches

#### 2. Introduction to Basic Electricity

##### Current Electricity

Definition of Resistance, Voltage, Current, Power, Energy and their units, Relation between electrical, mechanical and thermal units, Temperature variation of resistance, Difference between AC and DC voltage and current.

### **D.C. Circuits**

Ohm's Law, Series – parallel resistance circuits, calculation of equivalent resistance, Kirchhoff's Laws and their applications.

### **Electric Cells**

Primary cell, wet cell, dry cell, battery, Li-ion battery, series and parallel connections of cells, Secondary cells, Lead Acid Cell, Discharging and recharging of cells, preparation of electrolyte, care and maintenance of secondary cells.

### **Lighting Effects of Current**

Lighting effect of electric current, filaments used in lamps, and Tubelight, LED, their working and applications.

### **Capacitors**

Capacitor and its capacity, Concept of charging and Discharging of capacitors, Types of Capacitors and their use in circuits, Series and parallel connection of capacitors, Energy stored in a capacitor.

### **3. Introduction and Identification of Electronics Components**

- Electronic controls in a common way
  - Diode, Transistors, Op-Amp
  - Number systems and Boolean Algebra
  - Logic Gates
  - Flip-Flops
  - Counters
  - Multiplexers
  - Decoders
  - LED, LCD and 7 segment display
  - RAM and ROM
4. Concept of Amplification factor, Gain & Signal distortion
  5. Protocols like TCP/IP for communication purpose and for digital networks & circuits.

### **Tools, Equipment and Safety Measures-I**

1. Cables & Connectors
  - Non-Metallic Sheathed Cable
  - Un grounded & Grounded Power Supply Cable
  - Metallic Sheathed Cable
  - Multi-Conductor Cable
  - Coaxial Cable
  - Unshielded Twisted Pair Cable
  - Shielded twisted pair cable
  - Ribbon Cable
  - Armoured & Unarmoured Cable
  - Twin-Lead Cable
  - Twin axial Cable
  - Optical fiber cable
  - Connectors
1. ESD Clothing
  - What to wear, how to wear



## **Soldering & De-Soldering of Components-I**

### 1. Soldering & De Soldering of Basic Components

- Soldering Tools
- Different types of Soldering Guns related to Temperature and wattages, types of tips
- Solder materials and their grading
- Soldering and De Soldering Stations and their Specifications
- Preparing Component for Soldering
- PCB Applications
- Types of PCB
- Soldering Basic Components on PCB
- De soldering Basic Components
- Safety precautions while Soldering & De soldering
- Check for cold continuity of PCB
- Identification of loose/dry solder, broken tracks on printed wire assemblies & discrete components mounted circuit boards
- Join the broken PCB track and test
- De soldering using Pump and wick
- Introduction of SMD Components

### **Identification of Components, Tools, SOP & Work Instructions-I (Lab)**

1. Identification & working of various electronic components
2. Working of testing equipment
3. Measurement using Multimeter & Clamp meter
4. Battery health check-up
5. Measure and test the voltage of given cells.
6. Verification of truth tables for AND, OR, NOT and NAND logic gates.
7. Verification of truth tables for NOR, XOR and XNOR logic gates.
8. Construction and verification of operations of half adder and full adder circuits using basic gates.
9. Study and verification of truth tables for 3 line to 8 line decoder.
10. Study and verification of truth tables for 4:1 MUX using gates
11. Study and verification of truth tables for 1:4 DEMUX using gates.
12. Construction and verification of truth tables for S-R, D and J-K flip flops.
13. Study and verification of truth table for universal shift register.
14. Study the operation of a synchronous counter.

### **Electronic Measurement and Instrumentation -I (Lab)**

1. Study of semiconductor diode voltmeter and its use as DC average responding AC voltmeter.
2. Study of L.C.R. bridge and determination of the value of the given components.
3. Study of distortion factor meter and determination of the % distortion of the given oscillator.
4. Study of the transistor tester and determination of the parameters of the given transistors.

## ***Level 5 (Semester II)***

### **Electronic Measurements and Instrumentation - II**

Voltmeter and ammeter methods, Wheatstone bridge, low resistance measurements, low resistance measuring instruments AC bridge theory, capacitance bridges, Inductance bridges, Q meter

CRO: CRT, wave form display, time base, dual trace oscilloscope, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Oscilloscope specifications and performance. Delay time based Oscilloscopes, Sampling Oscilloscope, DSO, DSO applications Instrument calibration: Comparison method, digital multimeters as standard instrument, calibration instrument Recorders: X-Y recorders, plotters

### **Identification of Components, Tools, SOP & Work Instructions-II**

- 1 Introduction to wireless communication
- 2 Signal Converters
- 3 Tools & their Uses
  - Use of tester to monitor AC Power
  - Skin the electrical wires/cables using the wire stripper and cutter
  - Main cable for control & electronic circuit wires
  - Crimping tools and buses
- 4 Introduction to measuring equipment's
  - Signal generator's
  - CRO
  - Function Generators
  - Frequency Counter
  - Logic analyzer
  - Spectrum analyzer
  - LCRQ Meter
- 5 Standard Operating Procedures and Work Instructions
  - What is SOP and WI
  - How to read & follow SOP and WI
  - Overall Quality Assurance Plan

### **Tools, Equipment & Safety Measures-II**

1. Tools & Equipment
  - Types of tools & equipment required and deployed in manufacturing, installing & servicing
  - Identification and termination process
  - General maintenance of tools/equipment and recalibration of Test equipment
  - General safety and common-sense safety
2. PPE
  - Usage & benefits of PPE

- Types & usage of various PPE
  - Maintenance of PPE
2. Clean Room Environment
    - Do's and Don't
    - Shop Floor Discipline

## **Soldering & De-soldering components & Emergency actions**

### 1. Introduction to SMD Components

- Identification of 2, 3, 4 terminal SMD components
- Soldering the SMD components on the PCB
- Make the necessary settings on SMD soldering station to solder various ICs of different packages by choosing proper clamping tools
- Identify various connections and the setup required for SMD soldering station
- De solder the SMD components from the given PCB
- Make the necessary settings on SMD soldering station to de solder various ICs of different packages by choosing proper clamping tools
- Make a panel board using different types of switches for a given application
- Identification of crimping tools for various IC packages
- Reliable Soldering Practices

### 2. Emergency actions

- Minimum Requirements
- Reporting Emergencies
- Emergency exits
- Primary and secondary evacuation routes
- Locations of fire extinguishers
- Fire alarm pull stations' location
- Assembly points
- Medical Services

## **Soldering & De-soldering of components - II Lab**

1. Assemble the product
2. Dis-assemble the product
3. Safety Precautions & emergency plans

## **Electronic Measurement-II Lab**

1. Study of the following transducer (i) PT-100 trans (ii) J- type trans. (iii) K-type trans (iv) Pressure transducer
2. Measurement of phase difference and frequency using CRO (lissajous figure)
3. Measurement of low resistance Kelvin's double bridge.
4. Radio Receiver Measurements

## Level 6 (Semester III) Fault Analysis & Repairs

1. Classification of fault
2. Identification of fault
3. Rectification of fault
4. Repairing/Replacing Module
5. Analysis for the different types of equipment's
  - Smartphones
  - Air Conditioning
  - Security systems
  - Electronically controlled doors
6. Fault analysis based on hardware and software component
7. Diagnostic and Testing Methods
8. Visual Inspection
9. Earth Continuity Test
10. Insulation Resistance Test

### (6.GV.02) Good Manufacturing Concept & Practices – I

- TQM (Total Quality Management) & Kaizen
- Inventory Management & Logistics in brief
- Quality assurance
- Checklist
- SWOT analysis
- Lean Manufacturing
- Muda, Mura & Muri – Toyota Production System (TPS)
- Spatial considerations & other related concepts

### Electronics Devices & Circuit-I

#### Unit I

Energy Bands and Charge Carrier in Semiconductor: Bonding forces and energy bands in solids, Charge Carriers in Semiconductors, Carrier Concentrations, Drift Mechanism. Excess carriers in Semiconductors: Optical Absorption, Carrier Lifetime: Direct Recombination, Steady State Carrier Generation, Quasi-Fermi Level, Diffusion of carriers and Einstein relation.

**UNIT II Junctions:** Equilibrium Conditions, Forward and Revers Biased Junctions; Steady State Conditions. Optoelectronic Devices: Photodiode V-I characteristic, Photodetector, Solar Cells, Light Emitting Diode. Introduction to Thyristors, PNP diode, SCR, LASCR, DIAC, TRIAC

### Electronics System Packaging and Manufacturing

Evolution and Classification of Printed Circuit Boards, Challenges in Modern PCB Design and Manufacture, PCB fabrication methodologies (SSB, DSB and multilayer board), PCB design considerations/ design rules for analog, digital and power applications, Electromagnetic

interference in electronic systems and its impact. Analysis of electronic circuit from noise emission point of view (both conducted and radiated emission) cross talk and reflection behavior of the circuit in time domain, Thermal management of electronic devices and systems.

Semiconductor Packages: Single chip packages or modules. (SCM) Commonly used packages and advanced packages; Materials in packages, Current trends in Packaging, Multichip modules (MCM)-types; System-in package (SIP); Packaging roadmaps; Hybrid circuits. Pipe and FIFOs, Shared memory, Sockets

### **Electronic Devices and Circuits Lab**

1. Study of Lab Equipments and Components: CRO, Multimeter, and Function Generator, Power supply- Active, Passive Components and Bread Board.
2. P-N Junction diode: Characteristics of PN Junction diode - Static and dynamic resistance measurement from graph.
3. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of  $V_{rms}$ ,  $V_{dc}$ , and ripple factor.
4. Characteristics of Zener diode: V-I characteristics of zener diode, Graphical measurement of forward and reverse resistance.
5. Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.
6. Study CE configuration for NPN and PNP transistors and measurement of voltage and current gain.
7. Study CB configuration for NPN and PNP transistors and measurement of voltage and current gain.
8. Study CC configuration for NPN and PNP transistors and measurement of voltage and current gain.

### **Fault Analysis & Repairs - Lab**

1. Categorization of faults
  - Hardware/Software, User Induced, Component Failures
  - L0 to L4 repairs
2. Testing electrical/electronic components in the product
3. Troubleshoot and repair of the faults identified in the product
  - Microphone
  - Musical Instruments (Loudspeakers)
  - Recorder (CD/ DVD Player)
4. Preventive Maintenance Services
5. Basic Occupational Safety and Precautions
6. Microphones and Loudspeakers

## Level 6 (Semester IV)

### Good Manufacturing Concepts & Practices – II

- Work Study Concepts
  - Method study
  - Work measurement
  - Sequencing of Operations and timing the flow steps
  - Advantages of work study
- Team Working
  - Forming
  - Storming
  - Norming
  - Performing
  - Adjourning

### Manufacturing & Quality Norms

1. Manufacturing & Quality Norms- keep it differently according to all applications
  - Manpower Deployment and Operations as per Work Instructions and criticality of the process Understanding how to form each operation and practical training of operation
  - Understanding accept and reject criterion of a particular operation. Practical training of testing/checking each operation
  - Quality Norms of accept and practical training of electronic equipment's/Devices
  - Acceptance/ Rejection training of various defects
2. Manufacturing & Quality Norms – II
  - Process in packing line-Packing line Operations sequence flow and its importance
  - Quality Systems - Accept, Reject criterion of various tests at OQA
  - Training of Assembly of electronic components - Assemble, Check, test electronic components
  - Various Labels and their Importance - Understanding Labels, Scanning and its importance
  - Packing of components/devices - Various Stages of packing
  - Acceptance, Reject and sampling following QA norms - AQL level, Sampling techniques, as per QA sampling accept, reject numbers

### Good Manufacturing Concepts & Practices – III

1. Good Manufacturing Concepts & Practices - II
  - Brief Introduction
  - Total Quality Management
    - ISO Standards
  - Kaizen
  - Toyota Production System

- Lean Manufacturing
  - Combination of Inventory
  - Supply Chain
- Quality and Inspection
  - 3 Sigma and 6 Sigma Orientation

### **Electronic Devices and Circuits –II**

**UNIT I MOSFET:** Device structure and its operation in equilibrium, V-I characteristics. Circuits at DC, MOSFET as Amplifier and switch, Biasing in MOS amplifier circuits, small-signal operation and models, single stage MOS amplifier, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier

**UNIT II BJT:** Review of device structure operation and V-I characteristics, BJT circuits at DC, BJT as amplifier and switch, biasing in BJT amplifier circuit, small-signal operation and models, single stage BJT amplifier, BJT internal capacitances and high frequency model, frequency response of CE amplifier.

**UNIT III Feedback:** The general feedback structure, properties of negative feedback, the four basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, the shunt-shunt and shunt series feedback amplifier. Oscillators: Basic principles of sinusoidal oscillators, op-amp RC oscillator circuits, LC oscillator

### **Electronic Devices and Circuits –II Lab**

1. Characteristic of BJT: BJT in CE configuration- Graphical measurement of hparameters from input and output characteristics. Measurement of  $A_v$ ,  $A_i$ ,  $R_o$  and  $R_i$  of CE amplifier with potential divider biasing.
2. Measurement of Operational Amplifier Parameters: Common Mode Gain, Differential Mode Gain, CMRR, Slew Rate.
3. Applications of Op-amp: Op-amp as summing amplifier, Difference amplifier, Integrator and differentiator.
4. Field Effect Transistors: Single stage Common source FET amplifier –plot of gain in dB Vs frequency, Measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
5. Oscillators: Sinusoidal Oscillators a. Wein’s bridge oscillator b. phase shift oscillator.

### **Manufacturing Practices**

1. Work study concepts
2. Team work concepts

## Level 7 (Semester V)

### Valuations & Storage

1. Valuation
  - Specific Item cost
  - Weighted average cost
2. Storage
  - Stacking Norms
  - Bin Cards
  - Stores Layout
  - Categorization of Materials
    - Hazardous/Non-Hazardous
    - Imported/Local
    - Assembly/ Parts
    - Consumables
    - Class A/B/C
    - Good/defective

### Shelf Life, Ware House Operations Management & Material Transactions

1. Shelf Life Management
  - FIFO
  - FILO
  - LIFO
  - LILO
2. Material Transactions
  - Inward
  - Outward
  - Suspense
  - RMA (Return Material Authorization)
  - Insurance

### Industrial Electronic Product Design

Development Process, Product Planning & Conceptualization, Product Architecture and Industrial Design, Product Manufacturing & Prototyping, Economic Analysis & Managing Projects. Introduction to 3-D printing and Rapid Prototyping

### Pre-Production Activities

Pre-Production activities

- Layout
- Time Study & Motion Study
- Two Hand Insertion
- Non-value adding activities
- Positioning of Bins
- Line Balancing



## Pre-Production Activities Lab

- Pre-Production activities
  - Two Hand Insertion
  - Positioning of Bins
- House Keeping
- 5S

## Valuations & Storage Lab

- Categorization of Raw Material & Consumables
  - Hazardous/Non-Hazardous
  - Imported/Local
  - Assembly/Parts
  - Class A/B/C
  - Good/defective
- Material Transactions
  - Inward
  - Outward
  - Suspense

## Level 7 (Semester II)

### Accounting & Management/ Entrepreneurship

#### 1. Introduction

Meaning and Nature of Management, Management Approaches, Processes, Managerial Skills, Tasks and Responsibilities of a Professional Manager.

#### 2. Organizational Structure and Process

Organizational Culture and Climate, Managerial Ethos, Organization Structure & Design, and Managerial Communication.

#### 3. Planning and Controlling

Planning Types and Process, Management by Objectives, Decision-Making Types and Models, Problem Solving Techniques, Controlling: Process and Techniques.

#### 4. Performance Evaluation Techniques:

Introduction to Budgeting and Budgetary Control; Performance Budgeting; Classification of Budget; Standard Costing and Variance Analysis; Balanced Scorecard; Responsibility Accounting.

#### 5. Decision Making Techniques:

Cost Volume Profit Analysis; Management Accounting for Decision Making and Control; EVA and Performance Measurement; Introduction to Activity Base Costing, Targeting Costing, Life Cycle Costing; Uniform Costing.

Or

**Course Contents:**

1. Entrepreneurship: Concept and Definitions; Entrepreneurship and Economic Development; Classification and Types of Entrepreneurs; Entrepreneurial Competencies; Factor Affecting Entrepreneurial Growth – Economic, Non-Economic Factors; EDP Programmes; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs; Entrepreneur; Manager Vs. Entrepreneur.
2. Opportunity / Identification and Product Selection: Entrepreneurial Opportunity Search and Identification; Criteria to Select a Product; Conducting Feasibility Studies; Project Finalization; Sources of Information.
3. Small Enterprises and Enterprise Launching Formalities : Definition of Small Scale; Rationale; Objective; Scope; Role of SSI in Economic Development of India; SSI; Registration; NOC from Pollution Board; Machinery and Equipment Selection; Project Report Preparation; Specimen of Project Report; Project Planning and Scheduling using Networking Techniques of PERT / CPM; Methods of Project Appraisal.
4. Role of Support Institutions and Management of Small Business : Director of Industries; DIC; SIDO; SIDBI; Small Industries Development Corporation (SIDC); SISI; NSIC; NISBUD; State Financial Corporation SIC; Marketing Management; Production Management; Finance Management; Human Resource Management; Export Marketing; Case Studies-At least 4 (four) in whole course

**Trouble Shooting & Maintenance of Electronics Equipment's-II**

1. **TV System**
  - Working principle with block diagram of TV transmitter and receiver, Brief description with circuit diagram: TV Tuner, Video IF stage, Sound stage, Picture tube & its associated circuit, Synchronizing circuits, Horizontal & vertical deflection circuits, Remote control of a TV receiver, Idea of bandwidth, blanking and synchronization pulses, modulation scheme, colour transmission.
  - Cable type TV system, Head end processor, Trunk & cable distribution system with block diagram, Scrambling.
  - Introduction to LCD and LED TV systems, Introduction to high definition systems. Steps for Fault finding & Analysis.
2. **Modern Appliances**
  - Working principle and block diagram of following: Microwave oven, Telephone, Fax machine, Printers, Scanners. Steps for Fault finding & Analysis.

**Project Work**

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc.**

**Medical Imaging Technology (MI)**

**Branch Code: 112**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

## **1. Course Objectives**

After successfully completing the vocational course, the student would have acquired relevant appropriate and adequate technical knowledge together with the professional skills and competencies in the field of Medical Imaging Technology so that he/she is properly equipped to take up gainful employment in this Vocation. Thus he/she should have acquired.

### **A. Understanding of**

- (a) The relevant basic concepts and principles in basic science subjects (Physics, Chemistry and Biology) so that he/she is able to understand the different vocational subjects.
- (b) The basic concepts in engineering drawing.
- (c) The concepts, principles of working of basic electronic devices and circuits.
- (d) The knowledge of procedures of medical imaging.
- (e) The procedure of operation and upkeep of Medical Imaging equipments.
- (f) The concepts and principles used in safety while using equipments.

### **B. Adequate Professional Skills and Competencies in**

- (a) Testing different electronic components.
- (b) Testing the performance of electronic circuits.
- (c) Locating the fault at component level and at the stage level.

### **C. A Healthy and Professional Attitude so that He/She has**

- (a) An analytical approach while working on a job.
  - (b) An open mind while locating/rectifying faults.
  - (c) Respect for working with his/her own hands.
  - (d) Respect for honesty, punctuality and truthfulness.
-

## Curriculum

<b>Semester-I(NSQF Level-5)</b>											
S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV511	Electronic Measurement and Instrumentation -I	30	10	5	5	20	30		50	2
2	BMIV512	Basic Anatomy (Cross Sectional Anatomy-II)	30	10	5	5	20	30		50	2
3	BMIV513	Tools, Equipment & Safety Measures –I	30	10	5	5	20	30		50	2
4	BMIV514	Soldering & De-Soldering of Components –I	30	10	5	5	20	30		50	2
5	BMIP511	Identification of Components, Tools, Equipment and its working –Lab	30				20		30	50	2
6	BMIP512	Basic diagnostics (Lab)	30				20		30	50	2
7	BMIP513	Language Lab	30				20		30	<b>50</b>	<b>2</b>
8	On-Job-Training (OJT)/Qualification Packs		400hr/8 weeks				150			150	12
	<b>Total</b>									500	24

Semester-II(NSQF Level-5)											
S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV521	Electronic Measurement and Instrumentation –II	30	10	5	5	20	30		50	2
2	BMIV522	Basic Imaging	30	10	5	5	20	30		50	2
3	BMIV523	Tools, Equipment & Safety Measures –II	30	10	5	5	20	30		50	2
4	BMIV524	Soldering & De-Soldering of Components & Emergency actions II	30	10	5	5	20	30		50	2
5	BMIP521	Soldering & De-Soldering of Components-Lab	30				20		30	50	2
6	BMIP522	Basic Imaging Practical Lab	30				20		30	50	2
7	BMIP523	IT Tool Lab	30				20		30	50	2
8	<b>On-Job-Training (OJT)/Qualification Packs</b> (To continue with the same QP as opted in Level 5 First semester)		400hr/8 weeks				150			150	12
<b>Total</b>										500	24

Semester-III(NSQF Level-6)											
S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV631	Fault analysis & Repairs	30	10	5	5	20	30		50	2
2	BMIV632	Cross Sectional Anatomy-II	30	10	5	5	20	30		50	2
3	BMIV633	Electronics Devices Circuit –I	30	10	5	5	20	30		50	2
4	BMIV634	Radiation and administrative Issues	30	10	5	5	20	30		50	2
5	BKVH631	Human Values and Professional Ethics	30	10	5	5	20	30		<b>50</b>	<b>2</b>
6	BMIP631	Electronics Devices CircuitsILab	30				20		30	50	1
7	BMIP632	Fault analysis & Repairs -Lab	30				20		30	50	1
7	<b>On-Job-Training (OJT)/Qualification Packs</b> AssistantDuty Manager - Patient Relation Services (HSS/Q6103)		400hr/8 weeks						150	150	12
	<b>Total</b>									500	24
Semester-IV(NSQF Level-6)											
S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV641	CT and Ultrasound	30	10	5	5	20	30		50	2
2	BMIV642	Manufacturing & Quality Norms	30	10	5	5	20	30		50	2
3	BMIV643	Electronics Devices Circuit –II	30	10	5	5	20	30		50	2
	BKVE641	Environment and Ecology	30	10	5	5	20	30		<b>50</b>	<b>2</b>
4	BMIP641	Electronics Devices Circuit II Lab	30				20		30	50	2
	BMIP642	Manufacturing Practices	30				20		30	50	1
	BMIP643	CT and Ultrasound Lab	30				20		30	50	2
7	<b>On-Job-Training (OJT)/Qualification Packs</b> (To continue with the same QP as opted in Level 6 First semester)		400hr/8 weeks						150	150	12
	<b>Total</b>		580							500	24

Semester-V(NSQF Level-7)											
S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV751	MRI, Image Processing and Recording	60	20	10	10	40	60		100	4
2	BMIV752	Advanced Imaging	30	10	5	5	20	30		50	2
	BKVH751	Constitution of India, Law and Engineering	30	10	5	5	20	30		50	2
3	BMIP751	MRI, Image Processing and Recording	30				20		30	50	2
4	BMIP752	Advanced Imaging	30				20		30	50	2
5	<b>On-Job-Training (OJT)/Qualification Packs</b> (Duty Manager - Patient Relation Services (HSS/Q6104))		400hr/8 weeks							200	12
	<b>Total</b>		580							500	24

Semester-VI(NSQF Level-7)											
S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV761	Admin, Medico Legal and interventional Procedures	60	20	10	10	40	60		100	4
2	BMIV762	Project	60	20	10	10	40	60		100	4
	BKVH761	Indian Tradition, Culture and Society	30	10	5	5	20	30		50	2
3	BMIP761	Admin, Medico Legal and Interventional Procedures	30				20		30	50	2
4	<b>On-Job-Training (OJT)/Qualification Packs</b> (The practical and theory need to be performed in a hospital/radiological centre) To continue with the same QP as opted in Level 7 First semester		400hr/8 weeks							200	12
	<b>Total</b>		580							500	24



**Detailed**  
**Curriculum(Semester I)**

**Electronic Measurements and Instrumentation-II**

Unit, dimensions and standards: Scientific notations and metric prefixes. SI electrical units, SI temperature scales, Other unit systems, dimension and standards.

Measurement Errors: Gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, Measurement error combination, basics of statistical analysis.

PMMC instrument, galvanometer, DC ammeter, DC voltmeter, series ohm meter

Transistor voltmeter circuits, AC electronic voltmeter, current measurement with electronic instruments, probes Digital voltmeter systems, digital multimeters, digital frequency meter system.

**Basic Anatomy (Cross Sectional Anatomy-II)**

1. Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology
2. Anatomy of the upper thorax and mid thorax- Surface anatomy relationships, Bony structures and muscles, Blood vessels, Lungs, heart and great vessels, Esophagus
3. Anatomy of the Abdomen- Major organs and their accessories, Abdominal bloodvessels
4. Anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems
5. Neuro Anatomy- Scan planes
6. Brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves
7. Spine- Vertebra and disc, Spinal cord and meninges
8. Neck- Arterial/venous systems, Muscles, Glands and pharynx

**Tools, Equipment and Safety Measures-I**

**1. Cables & Connectors**

- Non-Metallic Sheathed Cable
- Un grounded & Grounded Power Supply Cable
- Metallic Sheathed Cable
- Multi-Conductor Cable
- Coaxial Cable
- Unshielded Twisted Pair Cable
- Shielded twisted pair cable
- Ribbon Cable
- Armoured & Unarmoured Cable
- Twin-Lead Cable
- Twin axial Cable
- Optical fiber cable
- Connectors

**2. ESD Clothing**

- What to wear, how to wear

## **Soldering & De-Soldering of Components-I**

### 1. Soldering & De Soldering of Basic Components

- Soldering Tools
- Different types of Soldering Guns related to Temperature and wattages, types of tips
- Solder materials and their grading
- Soldering and De Soldering Stations and their Specifications
- Preparing Component for Soldering
- PCB Applications
- Types of PCB
- Soldering Basic Components on PCB
- De soldering Basic Components
- Safety precautions while Soldering & De soldering
- Check for cold continuity of PCB
- Identification of loose/dry solder, broken tracks on printed wire assemblies & discrete components mounted circuit boards
- Join the broken PCB track and test
- De soldering using Pump and wick
- Introduction of SMD Components

### **Identification of Components, Tools, Equipment's & working - Lab**

1. Identification & working of various electronic components
2. Working of testing equipment
3. Measurement using Multimeter & Clamp meter
4. Battery health check-up
5. Measure and test the voltage of given cells.

## **Basic Diagnostics (Lab)**

### **1. X-Ray Imaging**

- X-Ray Tubes.
- Stationary & Rotation Anode.
- X-ray Consolestation (Demo of KV, MA and exposure time settings).
- Procedures to reduce Scattered Radiation.
- Focus Principle.
- Grids.
- Screen.
- Image intensifiers.
- Use of contrast materials.

### **2. Dark Room Technique**

- Images to ring devices.
- Film cassette construction.
- Duplicating a films
- Spectrum.
- Films types - Specialized use.
- Operation, storage.
- Photo chemistry.
- Development.
- Fixing.
- Radiation protection, counters.
- Assessment.

### **3. Radiological Positioning**

- Patient transfer technique.
- Turning the patient.
- Restraint techniques - Trauma, Pediatric, Geriatric, physically handicapped, disturbed patients, an aesthetized patient, moving chair & stretcherpatients.
- Tubes & catheters, Nasogastric, chest, Urinary, intravenous, oxygen & other (Castsurgical & cardiac) Alcoholic, bed pans & urinals.
- Assessment.

## (Semester II)

### Electronic Measurements and Instrumentation - II

Voltmeter and ammeter methods, Wheatstone bridge, low resistance measurements, low resistance measuring instruments AC bridge theory, capacitance bridges, Inductance bridges, Q meter

CRO: CRT, wave form display, time base, dual trace oscilloscope, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Oscilloscope specifications and performance. Delay time based Oscilloscopes, Sampling Oscilloscope, DSO, DSO applications

Instrument calibration: Comparison method, digital multimeters as standard instrument, calibration instrument Recorders: X-Y recorders, plotters

### Basic Imaging

- 1. The photographic Process:** Introduction, visible light, images produced by radiation, light sensitive photographic materials.
- 2. Image Characteristic:** Real and mental images, reflected, transmitted and emitted light images Photographic emulsions. The photographic latent image. Positive process
- 3. Film materials in X-ray:** History, structure of an x- ray film, single and double emulsion films, types of films, cross over effect.
- 4. Spectral sensitivity** of film material, graininess of film material, speed and contrast of photographic materials.
- 5. Sensitometry:** Photographic density, characteristic curves, features of the characteristic curve.
- 6. Intensifying screens and cassettes.** Cassette design, care of cassettes, types of cassettes, and mounting of intensifying screens, loading and unloading of cassettes, Care of intensifying screens, tests to check screen film contact and lightleakage.
- 7. The fluorescent materials,** types of intensifying screens, intensification factor. The influence of KV, scattered radiation. Detail, sharpness and speed, size of the crystals, reciprocity failure, and quantum mottle.
- 8. Film processing:** Development. The nature of development-manual or automatic. The PH scale, constitution of developing solutions both in manual and automatic processing and properties of developing chemicals, development time, factors in the use of a developer, developer activity.
- 9. Dark Room:** Layout and planning. Dark room construction - Nature of floor, walls, ceiling and radiation protection, Dark room equipment and its layout. Location of pass through boxes or cassette hatches.
- 10. Radiographic Image:** Components in image quality-density, contrast and detail.
- 11. Photo Fluorography:** Cine cameras, cine fluorography, cine film, serial cameras, processing of cine films, flurographic films.

## **Tools, Equipment & Safety Measures-II**

1. Tools & Equipment
  - Types of tools & equipment required and deployed in manufacturing, installing & servicing
  - Identification and termination process
  - General maintenance of tools/equipment and recalibration of Test equipment
  - General safety and common-sense safety
2. PPE
  - Usage & benefits of PPE
  - Types & usage of various PPE
  - Maintenance of PPE
3. Clean Room Environment
  - Do's and Don't
  - Shop Floor Discipline

## **Soldering & De-soldering components & Emergency actions**

### **1. Introduction to SMD Components**

- Identification of 2, 3, 4 terminal SMD components
- Soldering the SMD components on the PCB
- Make the necessary settings on SMD soldering station to solder various ICs of different packages by choosing proper clamping tools
- Identify various connections and the setup required for SMD soldering station
- De solder the SMD components from the given PCB
- Make the necessary settings on SMD soldering station to de solder various ICs of different packages by choosing proper clamping tools
- Make a panel board using different types of switches for a given application
- Identification of crimping tools for various IC packages
- Reliable Soldering Practices

### **2. Emergency actions**

- Minimum Requirements
- Reporting Emergencies
- Emergency exits
- Primary and secondary evacuation routes
- Locations of fire extinguishers
- Fire alarm pull stations' location
- Assembly points
- Medical Services

### **Soldering & De-soldering components - Lab**

1. Assemble the product
2. Dis-assemble the product
3. Safety Precautions & emergency plans

### **Basic Imaging Practical's Lab**

1. Test to check the x-ray films and screen contact in the cassette
2. Test to check light leakage in the cassette.
3. To check the effect of safe light on exposed as well as unexposed x-ray film

### **IT Tools Lab.**

1. Spreadsheets, Word, Presentation
2. Multimedia Design
3. Troubleshooting
4. Project / Practical File
5. Viva Voce

### **(Semester III)**

#### **Fault Analysis & Repairs**

1. Classification of fault
2. Identification of fault
3. Rectification of fault
4. Repairing/Replacing Module
5. Analysis for the different types of equipment's
  - Smartphones
  - Air Conditioning
  - Security systems
  - Electronically controlled doors
6. Fault analysis based on hardware and software component
7. Diagnostic and Testing Methods
8. Visual Inspection
9. Earth Continuity Test
10. Insulation Resistance Test

#### **Cross Sectional Anatomy-II**

1. Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology
2. Anatomy of the upper thorax- Surface anatomy relationships, Bony structures and muscles, Blood vessels.
3. Divisions of the mid-thorax, heart and great vessels- Lungs, heart and great vessels, Esophagus
4. CT/MRI Images of the Thorax - Normal and pathologic
5. Anatomy of the Abdomen- Major organs and their accessories, Abdominal bloodvessels
6. CT/MR Images of Abdomen - Normal and pathologic
7. Anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems
8. Reproductive Organs
9. CT/MR Images of the Male/Female Pelvis- Normal and pathologic
10. Neuro Anatomy- Scan planes
11. Brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves
12. Spine- Vertebra and disc, Spinal cord and meninges
13. Neck- Arterial/venous systems, Muscles, Glands and pharynx

## Electronics Devices Circuit-I

### **Unit I**

Energy Bands and Charge Carrier in Semiconductor: Bonding forces and energy bands in solids, Charge Carriers in Semiconductors, Carrier Concentrations, Drift Mechanism. Excess carriers in Semiconductors: Optical Absorption, Carrier Lifetime: Direct Recombination, Steady State Carrier Generation, Quasi-Fermi Level, Diffusion of carriers and Einstein relation.

**UNIT II Junctions:** Equilibrium Conditions, Forward and Reverse Biased Junctions; Steady State Conditions. Optoelectronic Devices: Photodiode V-I characteristic, Photodetector, Solar Cells, Light Emitting Diode.

## Radiation & Administrative Issues

- 1. Quality Assurance:** General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually – machine calibration. Basic concepts of quality assurance, Radiation proof test; Resolution test; Phantom measurements - CT, US and MRI, Sensitometry, State and local regulations governing radiation protection practice.
- 2. Maintenance and care of equipment:** Safe operation of equipment, Routine cleaning of equipment and instruments, Cassette, screen maintenance, Maintenance of automatic processor and manual processing units, Routine maintenance of equipment.
- 3. Radiation protection:** Somatic and genetic radiation effects, Basis for occupational exposure limits, Ionizing radiation from natural and man-made source and their approximate dose equivalent contribution. Legal and ethical radiation protection responsibilities of radiation workers.
- 4. Units detection and measurement:** Units of radiation for exposure, absorbed dose, dose equivalent, and radio- activity, Quality factor to determine the dose equivalent.
- 5. Radiation detection devices:** Ion-Chambers, Proportional counter, Thermo-luminescent dosimeters (TLD), Appropriate application and limitation of each radiation detection device.
- 6. Personal monitoring and occupational exposures:** Monitoring devices, Body badges and ring badges. Thermo-luminescent dosimeters. Pocket ionization chambers. Applications, advantages and limitations of each device, Values for dose equivalent limits for occupational radiation exposures. Structures critical for potential life effect for whole body irradiation. Age proportion formula for the determination of a maximum accumulated dose equivalent.
- 7. Patient Protection:**

Relationship of beam limiting devices with radiation protection of patients, Added and inherent filtration, Purpose and importance of patient shielding, Patient shielding devices and radiographic procedures shielding to the radiographic procedures, Protection of women at child-bearing age, Methods to avoid repeat radiographs, Importance of clear, concise, instruction (effective communication skills) as a method of radiation protection, Effects of immobilization techniques to eliminate voluntary motions
- 8. AERB specifications:** Radiation safety (lead glass equivalence, lead lined doors) - room size - type approval – registrations & licenses - selection of exposure parameter for



various protocols – diagnostic reference levels.

### **Electronic Devices and Circuits Lab**

1. Study of Lab Equipments and Components: CRO, Multimeter, and Function Generator, Power supply- Active, Passive Components and Bread Board.
2. P-N Junction diode: Characteristics of PN Junction diode - Static and dynamic resistance measurement from graph.
3. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of  $V_{rms}$ ,  $V_{dc}$ , and ripple factor.
4. Characteristics of Zener diode: V-I characteristics of zener diode, Graphical measurement of forward and reverse resistance.
5. Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.

### **Fault Analysis & Repairs - Lab**

1. Categorization of faults
  - Hardware/Software, User Induced, Component Failures
  - L0 to L4 repairs
2. Testing electrical/electronic components in the product
3. Troubleshoot and repair of the faults identified in the product
4. Preventive Maintenance Services

## (Semester IV)

### CT and Ultrasound

#### 1. Computed Tomography (CT)

- **Basic Computed Tomography:** Basic principles of CT, generations of CT, CT instrumentation, image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality, CT image display
- **X-ray tube:** Construction working and limitations, generations, methods of cooling the anode, anode rating chart, speed of anode rotation, angle of anode inclination, Focus, anode heel effect, Effect of variation of anode voltage and filament temperature, inherent filter and added filter, bow tie filter, effect on quality of the spectrum.
- **Collimator designs:** Pencil beam, Fan beam, Cone beam CT, Z-axis collimation, detector design – construction and working - Gas filled detectors – solid state detectors – flat panel detectors.
- **Principles of tomography:** advantages and limitations – generations – spiral CT – slip ring technology - Multislice CT – dual source CT - pitch – rotation time.
- **Basic principles of Image Reconstruction:** Back projection, analytical and iterative methods – MPR – MIP – volume rendering – surface shaded display (SSD) – bone reconstruction.
- **CT artefacts:** motion artefacts, streak artefacts, ring artefacts, partial volume artefacts etc. causes and remedy.
- **Dose and Dosimetry:** CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD), Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurement Methods, Dose for Different Application Protocols, Technique Optimization
- **Advanced Computed Tomography:** Helical CT scan: Slip ring technology, advantages, multi detector array helical CT, cone – beam geometry, reconstruction of helical CT images, CT artifact, CT angiography, CT fluoroscopy, HRCT, post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR, CT Dose, patient preparation, Imaging techniques and protocols for various parts of body, CT contrast enhanced protocols – CT angiography – (Aortogram, selective angiogram head, neck and peripheral) image documentation and Filing, maintenance of equipment and accessories.
- **Technical Assessment and Equipment Purchase Recommendations**

#### 2. Ultrasonography

- **Basic Acoustics, Ultrasound terminologies:** acoustic pressure, power, intensity, impedance, speed, frequency, dB notation: relative acoustic pressure and relative acoustic intensity.
- **Interaction of US with matter:** reflection, transmission, scattering, refraction and absorption, attenuation and attenuation coefficients, US machine controls, US focusing.
- **Production of ultrasound:** Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam.
- **Ultrasound display modes:** A, B, M

- **Real-time ultrasound:** Line density and frame rate, Real-time ultrasound transducers: mechanical and electronic arrays, ultrasound artifacts, ultrasound recording devices, and Distance, area & volume measurements.
- **Techniques for imaging different anatomic areas, ultrasound artifacts, biological effects and safety.**
- **Doppler Ultrasound:** Doppler Theory, Doppler-Frequency Shift, Reflector Velocity Dependence, Doppler Angle Dependence, Spectral Analysis, Continuous Wave (CW) Doppler, Pulsed Doppler, Pulse Transmission and Range Gating, Aliasing, Duplex Scanning, Color Flow Imaging, Power Doppler, Patient preparation for Doppler, Doppler artifacts, vascular sonography.

### Manufacturing & Quality Norms

1. Manufacturing & Quality Norms- keep it differently according to all applications
  - Manpower Deployment and Operations as per Work Instructions and criticality of the process Understanding how to form each operation and practical training of operation
  - Understanding accept and reject criterion of a particular operation. Practical training of testing/checking each operation
  - Quality Norms of accept and practical training of electronic equipment's/Devices Acceptance/Rejection training of various defects
2. Manufacturing & Quality Norms – II
  - Process in packing line-packing line Operations sequence flow and its importance
  - Quality Systems - Accept, Reject criterion of various tests at OQA
  - Training of Assembly of electronic components - Assemble, Check, test electronic components
  - Various Labels and their Importance - Understanding Labels, Scanning and its importance
  - Packing of components/devices - Various Stages of packing
  - Acceptance, Reject and sampling following QA norms - AQL level, Sampling techniques, as per QA sampling accept, reject numbers

### Electronics Devices Circuit-II

1. Good Manufacturing Concepts & Practices - II
  - Brief Introduction
  - Total Quality Management
  - ISO Standards
2. Kaizen
3. Toyota Production System
4. Lean Manufacturing
  - Combination of Inventory
  - Supply Chain
5. Quality and Inspection
  - 3 Sigma and 6 Sigma Orientation

### **Electronic Devices and Circuits -II Lab**

1. Characteristic of BJT: BJT in CE configuration- Graphical measurement of parameters from input and output characteristics. Measurement of  $A_v$ ,  $A_i$ ,  $R_o$  and  $R_i$  of CE amplifier with potential divider biasing.
2. Measurement of Operational Amplifier Parameters: Common Mode Gain, Differential Mode Gain, CMRR, Slew Rate.
3. Applications of Op-amp: Op-amp as summing amplifier, Difference amplifier, Integrator and differentiator.
4. Field Effect Transistors: Single stage Common source FET amplifier –plot of gain in dB Vs frequency, Measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
5. Oscillators: Sinusoidal oscillators. Wein's bridge oscillator b. phase shift oscillator.

### **Manufacturing Practices**

1. Work study concepts
2. Team work concepts

### **CT and Ultrasound Lab**

## *(Semester V)*

### **MRI, Image Processing and Recording**

- 1. Basic concepts of Magnetic resonance imaging (MRI):** Atomic structure, Hydrogen as imaging medium, magnetism, precession, resonance, Electromagnetic radiation, NMR - basic concepts of MRI, Faraday's cage.
- 2. Basic MR Image formation:** RF Excitation, Relaxation (T1 and T2), Computation and display, Free induction decay, RF wave form designs.
- 3. Introduction to MR coils:** Volume coils, Gradient coils, Slice selection, phase encoding, frequency encoding
- 4. Artifacts:** Cause of artifacts, Image quality, image contrast, signal to noise ratio, resolution, artefacts, MR contrast agents, Advanced MR techniques, flow effects, MR angiography echo planner imaging, magnetization transfer, fat suppression, MR spectroscopy, functional imaging, Magnetic resonance hazards and safety, Recent development.
- 5. MRI Scanners:** Methods of MRI imaging methods; Head and Neck ,Thorax, Abdomen, Musculoskeletal System imaging; Clinical indications and contraindications; types of common sequences effects of sequence on imaging; Protocols for various studies, slice section, patient preparation; positioning of the patient; patient care-calibration - paramagnetic agents and dose, additional techniques and recent advances in MRI; image acquisition-modification of procedures in an unconscious or un co-operative patient; plain studies; contrast studies; special procedures; reconstructions; 3D images; MRS blood flow imaging, diffusion/perfusion scans; strength and limitations of MRI; role of radiographer.
- 6. MR safety:** instrumentation and biological effects

### **Advanced Imaging**

1. Computed Tomography its principle, various generations and advancements.
2. Ultrasonography, Color Doppler- its principle, advancements and applications.
3. Digital Radiography and Digital subtraction angiography equipment- principle, advancements and applications.
4. Fusion Imaging including PET-CT, PET- MRI.
5. Digital Mammography, DEXA equipment- principle, advancements and applications.
6. Tele radiology HIS, RIS and PACS
7. Image processing in digital radiography systems: Post processing techniques in console using CR, DR and flat panel fluoroscopy systems
8. Basic angiography and DSA

### **MRI, Image Processing and Recording**

1. MRI Images of the Thorax - Normal and pathologic
2. MR Images of Abdomen - Normal and pathologic
3. MR Images of the Male/Female Pelvis- Normal and pathologic
4. Neuro Anatomy- Scan planes brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves
5. Spine- Vertebra and disc, Spinal cord and meninges

### **Advanced Imaging**

1. Central Nervous System: Myelography, Cerebral studies, Ventriculography
2. Arthrography: Shoulder, Hip, Knee, Elbow
3. Angiography: Carotid Angiography (4 Vessel angiography), Thoracic and Arch Aortography, Selective studies: Renal, SMA, Coeliac axis, Vertebral angiography, Femoral arteriography, Angiocardiology
4. Venography: Peripheral venography, Cerebral venography, Inferior and superior venocavography, Relevant visceral phlebography
5. Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker, Electrophysiology
6. Gynaecology: Hysterosalpingography
7. Biliary system: Plain film radiography, Intravenous cholangiography, percutaneous cholangiography, Endoscopic retrograde cholangio-pancreatography. (ERCP), Operative cholangiography, Post-Operative cholangiography (T-tube Cholangiography)
8. Gastrointestinal tract: Barium meal, Barium swallow, Small bowel enema, Barium enema.
9. Renal tract: Intravenous urography, retrograde pyelography, micturating cystourethrography.
10. Other: Sialography

## (Semester VI)

### Admin, Medico Legal and Interventional Procedures

**1. Principals of Management:** Introduction to management, Strategic Management, Foundations of Planning, Planning Tools and Techniques, Decision Making, conflict and stress management, Managing Change and Innovation, Understanding Groups and Teams, Leadership, Time Management, Cost and efficiency.

**2. Medical law and ethics:** Medical ethics; Definition, Goal, Scope; Introduction to Code of conduct; Basic principles of medical ethics – Confidentiality; Malpractice and negligence; Autonomy and informed consent - Right of patients; Care of the terminally ill-Euthanasia ; Organ transplantation; Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects; Professional Indemnity insurance policy; Development of standardized protocol to avoid near miss or sentinel events; Obtaining an informed consent.

**3. Quality and patient safety:** Quality assurance; Concepts of Quality of Care, Quality Improvement Approaches, Standards and Norms, Quality Improvement Tools, Introduction to NABH guidelines; AERB specifications, radiation safety (lead glass equivalence, lead lined doors), room size, type approval, registrations & licenses, selection of exposure parameter for various protocols, diagnostic reference levels.

**4. Basics of emergency care and life support skills:** Basic life support (BLS), sudden Cardiac Arrest (SCA), cardiopulmonary resuscitation (CPR), Automated External Defibrillator (AED).

### Project

Project work may include case study related to Newer Imaging Technology.

### Admin, Medico Legal and Interventional Procedures

1. Quality assurance and Radiation safety survey in diagnostic X-ray installations.
2. Community orientation and clinical visit: Visit will include visit to the entire chain of healthcare delivery system - sub centre, PHC, CHC, SDH, DH and Medical College, private hospitals, dispensaries and clinics.
3. Governance at village level including interaction and group discussion with village panchayat and front line health workers.
4. Clinical visit to their respective professional department within the hospital.