



J.C. Bose University of Science & Technology YMCA, Faridabad

(A Haryana State Government University)

(Established by Haryana State Legislative Act No. 21 of 2009 & Recognized by UGC Act 1956 u/s 22 to Confer Degrees)

Accredited 'A' Grade by NAAC

COMMUNITY COLLEGE OF SKILL DEVELOPMENT

Sub: **Minutes of 7th Meeting of Board of Studies (BOS) Community College of Skill Development held on 18/05/2020 at 1.00 PM on the Zoom Application.**

Present:

1. Dr. Sanjeev Goyal, Principal CCSD & Nodal Officer, B.Voc : Chairperson
2. Dr. Rashmi Popli, Nodal officer, Community College : Member
3. Dr. Anju Gupta, Associate Professor, JCBUST, Faridabad : Member
4. Dr. Sandhya Dixit, Associate Professor, JCBUST, YMCA, Faridabad : Member
5. Sh. Parbhakar Yadav, Op. Manager, M/s Durga Threading Tools, Faridabad : Member

The following members could not attend the meeting: -

1. Mr. Pankaj Munjal
2. Representative of SSCs

At the outset, Dr.Sanjeev Goyal, Principal CCSD and Chairman-Board of Studies warmly welcomed all the members of the Board of Studies of Community College of Skill Development. The Chairman also appreciated the interest and the presence of outside members, who took pain to attend this meeting out of their busy schedule, for the healthy discussion on the academic development of the Community College.

Thereafter, the Agenda Items taken up and after detailed deliberation/discussion, the following decisions were taken.

Item No. BOS/07/01: To consider and confirm the Minutes of its previous meeting held on 24/10/2019.

The Board considered and confirmed the Minutes of its 6th meeting held on 24/10/2019.

Item No. BOS/07/02: To note the Action Taken Report (ATR) on the Minutes of BOS meeting held on 24/10/2019.

The Chairman informed the Board regarding the action taken on the minutes of BOS meeting held on 24/10/2019, where necessary. The Board noted the Action Taken Report, as placed before it.

Item No. BOS/07/03: To note the matter of starting of new course B.Voc in Banking financial and Insurance Services (BFSI) and also consider & approve the Scheme & syllabi with elective courses of B.Voc in Banking financial and Insurance Services (BFSI). (Annexure – A)

The Board noted the matter regarding the starting of the course B.Voc in Banking financial and Insurance Services (BFSI) from the session 2020-21 and after detailed deliberations/discussions approved the scheme & syllabi to be followed in B.Voc courses in Banking financial and Insurance Services (BFSI).

Item No. BOS/07/04: To consider and approve the scheme & syllabus of B.Voc courses in Automobile, Manufacturing, Electrical and Web Development. (Annexure – B)

It was brought to the notice of the Board that earlier the scheme & syllabi upto 2nd year of above courses were approved by the Board. It was informed by the Chairman (BOS) that as per requirement, some modifications have been made in the scheme and syllabi of these courses and elective subjects have been also introduced in the syllabus. However, the modified scheme & syllabi of B.Voc courses in Automobile, Electrical, Manufacturing, Web Development are placed before the Board for consideration and approval.

The board after detailed deliberations/discussions approved the scheme & syllabi to be followed in B.Voc courses in Automobile, Electrical, Manufacturing and Web Development.

Item No. BOS/07/04: To consider and approve the scheme & syllabus of PG Diploma Courses (Data Science & Analytics and Yoga Science & Naturopathy). (Annexure – C)

The board after detailed deliberations/discussions approved the scheme & syllabi to be followed in PG Diploma Courses (Data Science & Analytics and Yoga Science & Naturopathy).

Item No. BOS/07/05: To consider and approve the Fee structure-2020 of Community College of Skill Development.

The Board considered and approved the Fee Structure of Community College of Students.

Item No. BOS/07/06 : To consider and approve the proposal regarding following the University Examination Ordinances.

It was brought to the notice of the Board that conduct of examination in respect of CCSD students has been assigned to the Controller of Examination Office of the University. The Board considered and approved to follow the University Examination Ordinance for all courses.

Item No. BOS/07/07 : To consider and approve syllabus of Entrance Test for admission in B.Voc Courses.

The Board was informed that from the session 2020-21, the CCSD is going to organize an Entrance Test for all B.Voc Courses. The board considered and approved the syllabus of Entrance Test.

Item No. BOS/07/08: To consider and approve the list of teachers for taking classes and conducting internal examinations of CCSD students.

The Board after going through the agenda note approved the list of teachers for taking classes and conducting Internal Examinations of CCSD students with the suggestion that area of specialization of teachers should be mentioned in the list.

Item No. BOS/07/9: To consider and approve the Information Brochure of CCSD for Academic Session 2020-2021.

The Board after going through the Information Brochure-2020 of CCSD considered and approved the Information Brochure2020.

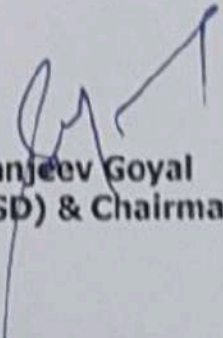
Item No. BOS/07/10: To consider and approve the Online Application Fee of B.Voc and Diploma Courses.

The Board considered and approved the Online Application Fee of B.Voc and Diploma Courses.

Item No. BOS/07/11: To consider and approve the minimum stipend Criteria for On Job Training (OJT) in Industries.

The Board considered and approved that the minimum stipend payable to the students for On Job Training (OJT) in Industries is Rs. 5000/- per month.

Meeting ended with a vote of thanks to the Chair.


Dr. Sanjeev Goyal
Principal (CCSD) & Chairman-BOS

SCHEME OF EXAMINATION
and
SYLLABUS
for
Bachelors in Vocation (B.Voc)
in
MANUFACTURING
Offered by
Community college of skill development



J C Bose University of Science & Technology YMCA
Sector-6, Mathura Road, Faridabad, Haryana, India

ABOUT THE PROGRAM

The B.Voc. Degree in manufacturing runs with a mission to impart knowledge, technical skills & hands-on training in production, focusing on manufacturing, quality control, CNC technology and machine maintenance. This program is an outcome of industry and student demand. Only Degree program in manufacturing with more than 80% Practical to make you more employable and outshine your career. This program is designed to introduce the students to the elements of engineering and management sciences and production technology consists of elements of operations research, production planning, materials management etc. Students under this program will use application of engineering and management techniques to simplify production process. The main aim of production technology is to solve problems and challenges arising in the field of production/manufacturing. Vocational training programs have been created with the aim of imparting industry-specific skills in students. These programs are crafted in such a way that the students acquire skills, which will lead them to employment in the respective sector.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO-1: To train students with practical skills and experimental practices related to core and applied areas of Manufacturing Technology to expand their knowledge horizon beyond books and make them industry ready.

PEO-2: To enable students to design and manufacture mechanical equipments which are useful for the industries.

PEO-3: To improve team building, team working and leadership skills of the students with high regard for ethical values and social responsibilities.

PEO- 4: To enable students to communicate effectively and efficiently.

PROGRAMME OUTCOMES (POs)

After completion of the program, the student will:

- 1) Be trained to NSQF level 7 in at least one job/profile in the field of automotive manufacturing skills
- 2) Be trained for multiple skill sets under the domain of manufacturing.
- 3) Be able to supervise the various workshop floors for mechanical shop, weldin and quality control.
- 4) Be trained & equipped with knowledge and understanding to start his/her own enterprise in manufacturing.
- 5) Be able to develop skills in management of customer issues, analysis and evaluation mechanical, electrical and electronics faults.
- 6) Be able to supervise the various manufacturing workshop floors for mechanical shop.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

- 1) To apply practical skills, vocational training and knowledge of Manufacturing fundamentals to industries.
- 2) The student will be ready and skilled to take-up career or to pursue higher studies with high regard to ethical values and social responsibilities.

SYLLABUS & SCHEME OF EXAMINATION

Year	FIRST SEMESTER			SECOND SEMESTER			
I	Course	Code	Credit	Course	Code	Credit	
	Communication Skills	BSC-101	3	Employability Skills - 1	BSC-206	3	
	Engineering Calculations	BSC-102	3	Applied Science	PCC-AM-205	3	
	Engineering Science	PCC-AM-106	3	Quality, inspection and Safety	PCC-AM-202	3	
	Manufacturing process-1	PCC-AM-101	3	Manufacturing process-2	PCC-AM-201	3	
	Manufacturing Workshop-1	PCC-AM-103	18	Manufacturing Workshop-2	PCC-AM-204	18	
	Cumulative Credits = 30 Certificate			Cumulative Credits = 60 Diploma			
NSQF LEVEL - 5 JOB ROLE – MACHINE SHOP SUPERVISOR (ASC/Q3505)							
Year	THIRD SEMESTER			FOURTH SEMESTER			
II	Machining and Machine Tools		3	On Job Training (OJT)/ Internship evaluation including report and presentation	PCC- AM-401	30	
	Material Science	PCC-AM-302	3				
	IT TOOLS	PCC-AM-306	3				
	Soft Skills	BSC-301	3				
	Manufacturing Workshop-3	PCC-AM-305	18				
	Total			30	Total		30
Cumulative Credits = 120 ADVANCED DIPLOMA							
NSQF LEVEL - 6 JOB ROLE – Machine Setter / Master Technician (ASC/Q3506)							
Year	FIFTH SEMESTER			SIXTH SEMESTER			
III	On Job Training (OJT)/ Internship	PCC-AM-501	30	Quality Control Techniques	PCC-M-604	3	
				Industrial Management	PCC-AM-603	3	
				Entrepreneurship	BSC-601	3	
				Project	BSC-602	3	
				Manufacturing Workshop-4	PCC-M-606	15	
				ELECTIVES (Choose any one)			3
				Reliability, Maintenance & Safety Engineering*	PCC-M-605		
				Plant Layout & Product Handling*	PCC-M-607		
				CAD & CAM*	PCC-M-608		
				Total			30
Cumulative Credits = 180 B.VOC							
NSQF LEVEL - 7 JOB ROLE - Supervisor Manufacturing (ASC/Q6306)							

FIRST SEMESTER

MANUFACTURING PROCESS-1

Semester 1st
Stream– Manufacturing
L T P Total Credits
3 0 0 3

Sessional – 25 Marks
Theory – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course objectives:

1. To study the various manufacturing processes.
2. To understand the working of various cutting tools.
3. To understand measurement and measuring instruments.
4. To introduce about NC and CNC machines.

Unit-1 Pre-machining activities:

does and don'ts of the manufacturing process, Metal properties/ metallurgy, coolant and lubricants, Selection of proper coolant and lubricant required for machining the required component, use of machine guards, acceptance requirements/ limits of machining e.g. surface finish, specific orientation, gauge inspection etc., introduction to jigs and fixtures, different holding fixtures, gears, stops, Introduction to Measuring devices: micrometers, vernier calipers, gauges, rulers.

Unit-2 Metal Cutting

Introduction to metal cutting, orthogonal and oblique cutting, types of chips, cutting tools, introduction to different types of tools used in the machining process, single point and multi point cutting tools, single point tool geometry, ASA tool signature, material removal rate.

Unit- 3 Machining

Different types of machining processes, basic fundamentals of machines and mechanics, introduction and operations of lathe, turning, milling, shaping, boring, broaching, hobbing, facing and shaping, blanking and piercing processes, special purpose machine for operations. grinding, grinding procedure, balancing and dressing of wheels, abrasive, Post machining activities: Impact of presence of burrs, edges, chips on the final product performance, de burring, use of chisels, scrapers to Trim, scrape or de burr objects or parts.

Unit- 4 Introductions to NC and CNC machines

NC machines, components of NC and CNC machines, difference between NC and CNC, G- codes and M codes, right command in the CNC machine, Introduction to quality, 7 quality tools, company policy.

Course outcomes:

1. Students will be able to differentiate between various manufacturing processes.

2. Students will be able to use different measuring instruments.
3. Students will learn about different machining operations.
4. Students will understand about NC and CNC machines.

Reference books:

1. Manufacturing technology by P. N. Rao
2. Production technology- R. K. Jain
3. Manufacturing Science- Amitabha Ghosh & Ashok Kumar Malik, - East- West Press.
4. Workshop Technology Vol I & II –Hazra & Chaudhary, Asian Book Comp., New Delhi.

ENGINEERING SCIENCE

Semester 1st

Stream– Manufacturing

L T P Total Credits

3 0 0 3

Sessional – 25 Marks

Theory – 75 Marks

Total: 100 Marks

Duration of Exam: 3 Hours

Course objectives:

1. To study the various unit systems.
2. To understand the concepts of forces and motions.
3. To understand thermodynamics.
4. To introduce about pollutions.

UNIT I: Units and Measurements

Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. Length, mass and time measurements; accuracy and precision of measuring instruments; errors in measurement; significant figures. Dimensions of physical quantities, dimensional analysis and its applications.

UNIT II: Laws of Motion

Intuitive concept of force, Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion.

Law of conservation of linear momentum and its applications.

Equilibrium of concurrent forces, Static and kinetic friction, laws of friction, rolling friction, lubrication.

Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on a banked road).

UNIT III: Thermodynamics

Heat, temperature, thermal expansion; thermal expansion of solids, liquids and gases, anomalous expansion of water; specific heat capacity; Cp, Cv - calorimetry; change of state - latent heat capacity. Thermal equilibrium and definition of temperature (zeroth law of thermodynamics), heat, work and internal energy. First law of thermodynamics, isothermal and adiabatic processes.

Second law of thermodynamics: reversible and irreversible processes, Heat engine and refrigerator.

UNIT IV: Fuel and their Classification

Definition, characteristics, classification into solid, liquid and gaseous fuel, Petroleum and brief idea of refining into various fractions and their characteristics and uses, Calorific value of fuel, Gaseous fuels- preparation, properties, composition and use of producer gas, water and oil gas.

UNIT V: Pollution & its Control

Air Pollution: Types of pollutants, source effects, sink and control of primary pollutants – CO, NO_x, HC, SO_x and particulates, effects of pollutants on man and environment – photochemical smog and acid rain. Water Pollution: Classification of pollutants, their sources, waste water treatment – domestic and industrial. Soil Pollution: Composition of soil, classification and effects of soil pollutants and their control. Hazardous Wastes: Classification – radioactive, biomedical and chemical, treatment and disposal – physical, chemical and biological processes.

Course outcomes:

1. Students will be able to differentiate different unit systems.
2. Students will be able to use different measuring instruments.
3. Students will learn about concepts of heat and motion.
4. Students will understand about pollution and its control.

Reference books:

1. Thermodynamics: P K Nag
2. Environmental pollution and control engineering: C. S. Rao
3. Hand book of industrial metrology – John W. Greve, Frank W. Wilson, PHI – New Delhi
4. Engineering Metrology – K.J. Hume, Macdonald and Co.(publisher) London

COMMUNICATION SKILLS

Semester -1st
Stream–Manufacturing
L T P Total Credits
3 0 0 3

Sessional – 25 Marks
Theory – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

1. To discuss types of communication and their forms
2. To improve comprehension
3. To improve spoken English and ability to articulate ideas
4. To improve formal writing skills

Unit 1: Introduction to Communication: Meaning, Importance and Function of Communication, Types of communication, language of communication; advantages and disadvantages; Barriers to Communication; Organizational Communication

Unit 2: Grammar: Parts of speech, Articles, Tenses, Formation of Sentences, Active and Passive Voice, Direct and Indirect speech.

Unit 3: Writing and Comprehension: Comprehension, Composition, Translation, Paraphrasing, Letter writing

Unit 4: 7 Cs of Communication; Grice's Cooperative Principle; Group Discussions; Public Speaking; Facing Interviews

Course Outcome:

1. To learn about communication process and ways to make communication effective by giving attention to all elements involved.
2. To improve grammar and gain confidence by enhancing their abilities to articulate their ideas.
3. To acquire better writing skills in formal communication.
4. To be able to revise documents for fruitful reading and comprehension.

Reference books:

1. Wren and Martin. *High School English Grammar and Composition*. New Delhi: RRP, 2007
2. Murphy, Raymond. *Essential English Grammar*. New Delhi: Cambridge, 2017

ENGINEERING CALCULATIONS

Semester 1st
Stream–Manufacturing
L T P Total Credits
3 0 0 3

Sessional – 25 Marks
Theory – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course Objectives

1. To familiarize the prospective engineers with Basics of mathematics
2. To understand fundamental arithmetical operations.
3. To learn Unit systems, Fractions and Decimals, roots, percentage.
4. To have Knowledge of differential quantities

Course Contents

Unit-I: Basic Aptitude- Fundamental Arithmetical Operation- Addition, Subtraction, Multiplication and Division. Applied Workshop Problems Involving Addition, Subtraction, Multiplication and Division, System Of Units – Definition, Different Types & System Of Units i.e.(C.G.S. & SI Units for Length, Mass, Area, Volume, Capacity, Time) HCF, LCM, Square Root Cube Root.

Unit-II: Trigonometry – Introduction, Trigonometric Identities, Quadrant Rule, Trigonometric Ratios of Some Specific Angles, Ratios of Complementary Angles, Introduction

Unit-III: Differentiation- Introduction to Derivatives, Product Rule, Quotient Rule, Chain Rule, Derivatives of Algebraic Function, Derivative of Trigonometric Functions.

Unit –IV: Integration: concepts of integration, integration of trigonometric, exponential and logarithmic functions, integration by parts.

Unit-V: Algebra- Algebraic Expressions and Identities, Terms Coefficients and Factors, Monomials Binomials and Polynomials, Multiplication and Division of Algebraic Expressions, Standard Identities and Their Applications.

Course Outcomes:

1. To Apply the Arithmetical Operations and Conversion of Units.
2. To Convert in Fraction and Decimals, Percentage.
3. To Solve HCF, LCM, Square Roots and Cube Roots.
4. To Deal with Differential Problems.
5. To Learn About Trigonometric Ratios.

Reference Books:

1. Mathematics Book by R.D Sharma
2. Advanced Engineering Mathematics: By Jain Rk.
3. A Basic Course in Mathematics: By Nabjyoti Dutta.
4. Skills in Mathematics: By Amit M Aggarwal.

MANUFACTURING WORKSHOP –I

(Covering all the practicals of ASC/Q3503)

Semester -1st
Stream–Manufacturing
L T P Total Credits
0 0 18 9

Internal – 25 Marks
External – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course objective:

1. To understand the safety measures of mechanical workshop.
2. To learn the functions of various conventional machines and unconventional machines.
3. To prepare different jobs by different machining operation.
4. To learn about CNC machine.

Course contents:

1. To Conduct all pre- machining operations:

- a) Measure and mark reference points/ cutting lines on the work pieces, using compasses, callipers, rulers and other measuring tools

- b) Understand the do's and don'ts of the manufacturing process as defined in SOPs/ Work Instructions
 - c) Set of machine stops or guides as per the specified lengths indicated through scales or work instructions
 - d) Set-up, adjust machine tools, fixtures/ jigs and cutting tools in order to perform machining operations
 - e) Check the centering and facing of the work pieces and check for alignment of the work pieces as per the final product output specifications
 - f) Gain knowledge on gear changing techniques and minor maintenance as per checklist
 - g) Check the working of different holding fixtures, gears, stops.
 - h) Brush or spray lubricating material on work pieces where applicable
 - i) Operate hand wheels or valves in order to feed the component and allow cooling and lubricating to the tool.
2. To understand various safety measures, working principle & specifications of various conventional machines (lathe, milling, shaper, grinder etc).
 3. To study elements of single point cutting tools and multiple point cutting tools.
 4. To prepare single point brazed tool with carbide tip on a mild steel shank involving milling and brazing operation.
 5. To prepare a job involving centering, facing, plain turning and step turning.
 6. To prepare a job by machining on milling/ shaper machine.
 7. To prepare a job by surface grinding on surface grinder and perform dressing and balancing of wheels
 8. To study and use boring/ broaching/ hobbing / facing/ shaping tools in different applications.
 9. To prepare a job by using blanking/ piercing and special purpose machines.
 10. To prepare a job on CNC machine and ensure that the right command is entered in the CNC machine as defined machining parameters.
- 11. To conduct all post machining operations:**
- a. Use files, hand grinders, wire brushes, or power tools for performing de burring operations.
 - b. Use chisels, scrapers, and other hand tools and equipment to Trim, scrape, or de burr objects or parts

- c. Clean the hydraulic tank/ Gauge/ Tools/ Fixtures as per the cleaning schedule and the process mentioned in the Work Instruction/ SOP manual
- d. Perform minor repairs and adjustments to the machine and notify supervisor/maintenance team when major service/ repair is required
- e. Measure the specifications of the finished component and verify conformance as per Control Plan/ Work Instruction
- f. Use devices like micrometers, vernier calipers, gauges, rulers and any other inspection equipment for measuring specifications with valid calibration status.
- g. Note down the observations of the basic inspection process and identify pieces which comply with the specified standards
- h. Organize changing different worn out machine accessories
- i. Ensure that the blunt tool is timely and safely replaced by a new tool
- j. Replace machine part as per work instructions, using hand tools or notify supervisor/ engineering personnel for taking corrective actions
- k. Ensure that the zero offset value is chosen at the time of tool changing process.

12. To maintain 5S at the work premises:

- a. Ensure the work area, tools, equipment and materials are clean
- b. Carry out storage of cleaning material and equipment in the correct location and in good condition
- c. Ensure self-cleanliness - clean uniform, clean shoes, clean gloves,
- d. Follow the daily cleaning standards and schedules to create a clean working environment
- e. Carry out sorting of materials, tools and equipment's and spare parts
- f. Follow proper labeling procedures
- g. Follow proper storage procedures
- h. Carry out segregation of waste into Hazardous and Non Hazardous waste and dispose the waste as per SOP
- i. Follow the floor markings/ area markings used for demarcating the various sections in the plant
- j. Follow 5S at workplace.

Course Outcomes: After studying this course the students will be able to:

1. Understand the safety measures of mechanical workshop.
2. Learn the functions of various conventional machines and unconventional machines.
3. Prepare different jobs by different machining operation.
4. Learn about CNC machine.

Reference books:

1. A course in workshop technology: manufacturing processes by B.S. Raghuwanshi.
2. Textbook of workshop technology by R S Khurmi and J k gupta.

SECOND SEMESTER

MANUFACTURING PROCESS – 2

Semester -2nd
Stream– B.Voc
L T P Total Credits
3 0 0 3

Sessional – 25 Marks
Theory – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course objectives:

- 1) To study the various manufacturing processes.
- 2) To understand the working of various cutting tools.
- 3) To understand measurement and measuring instruments.
- 4) To introduce about NC and CNC machines.

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: 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 3: SHAPING, PLANING & SLOTTING MACHINES: Working principles of planer, shaper and Slotter, Differences and similarities among them, types of work done on them, types of tools used, their geometry, General and periodic maintenance of a shaper.

UNIT 4: 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 5: 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 6: JIGS AND FIXTURES: Object of Jigs and Fixture, Difference between jigs and fixtures, Locating and clamping devices. Types of jigs, Simple example of milling, turning, grinding, horizontal boring fixtures and broaching fixtures.

Course outcomes:

- 1) Students will be able to differentiate between various manufacturing processes.
- 2) Students will be able to use different measuring instruments.
- 3) Students will learn about different machining operations.
- 4) Students will understand about NC and CNC machines.

Reference books:

1. Workshop Technology, Vol. I: Hazra & Chaudhry
2. Workshop Technology, Vol. I: BS Raghuvanshi
3. Karyashala Takniki: JK Kapoor

QUALITY, INSPECTION AND SAFETY

Semester -2nd
Stream- B.Voc
L T P Total Credits
3 0 0 3

Sessional – 25 Marks
Theory – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course objectives:

1. To understand the importance of safety, health and environment.
2. To classify different types of accidents.
3. To study different types of hazards.
4. To study about 5S at workplace.

UNIT-1: Importance of Safety, health and environment

Safety, Health and Environment, cleaning of work area, tools, equipment and materials, Importance of safety, objectives of safety management, personal protective equipment like safety gloves, safety glasses, safety shoes and safety helmet, contents of the first aid kit, instructions of equipment manual.

UNIT-2: Accidents: Classification of accidents, causes of accidents, accident investigations/reporting, approaches to prevent accidents, Firefighting.

UNIT -3: Safety in hazardous area: Hazards and risks, difference between hazard and risk, Hazard in industrial zones, physical, chemical, environmental, biological, ergonomics and psychosocial hazards, Introduction to OSHMS, OSHAS 18001 and OSHA.

UNIT-4: 5S in safety: The basic principles of 5 S in manufacturing and workplace – Cleaning, sorting etc, sorting of materials, tools and equipment's and spare parts, standards, procedures and

policies related to 5S, importance of waste disposal, segregation of waste into Hazardous and Non Hazardous waste, disposal the waste as per SOP, labeling procedures, storage procedures.

Unit-5: Inspection: how to measure the correct specifications of the output in the terms of thickness, hardness, durability, tightness, finesse etc. relevant manufacturing standards and procedures followed in the company in detail, different types of defects which may arise due to improper manufacturing

Unit-6 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.

Course outcomes:

1. Student will aware about safety and health.
2. Student will able to differentiate different types of accidents.
3. Student will able to differentiate different types of risks.
4. Student will learn about 5S at workplace.

Reference books:

1. Industrial Safety and Health Management by [C Ray Asfahl](#), pearson publications.
2. Industrial Safety Management by N. K. Tarafdar
3. Industrial Safety (Safety Management) by D S S Ganguly & C S Changeriya

APPLIED SCIENCE

Semester -2nd
Stream- B.Voc
L T P Total Credits
3 0 0 3

Sessional – 25 Marks
Theory – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course Objectives: Following are the objectives of this course:

- 1) To Learn concepts of Units, Laws of vectors, parallel forces, moment of force, couple.
- 2) To Learn the fundamentals of properties and behavior of the materials
- 3) Understand different types of communication systems
- 4) To know fundamental of advanced communication systems.

Course Contents:

Unit – I Basics of mechanics and force system: Significance and relevance of Mechanics, Statics, Dynamics. Space, time, mass, particle, flexible body and rigid body. Scalar and vector quantity, Units of measurement (SI units) - Fundamental units and derived units. Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle

of transmissibility of force, Force system and its classification. Resolution of a force - Orthogonal components of a force, moment of a force, Varignon's Theorem. Composition of forces – Resultant, analytical method for determination of resultant for concurrent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.

Unit– II Properties of solids: Definitions of deforming force, elasticity and plasticity, examples for elasticity and plasticity, definition of stress and its types with examples and its S.I unit, definition of strain and its types with examples, elastic limit, Hooke's law, stress - strain graph with explanation. Modulus of elasticity and its types, derivation of an expression for Young's modulus of a material. Definition of Compressibility and factor of safety. Simple problems on stress, strain and Young's modulus. Properties of liquids: Definition of thrust and pressure with S.I units. Definition of surface tension and its S.I unit, Viscosity.

Unit– III Transmission of heat: Definitions of conduction, convection and radiation with examples, definition of thermal conductivity, co-efficient of thermal conductivity(K) and its S.I unit. Applications of conduction, convection and radiation.

Unit– IV Thermodynamics: Introduction of thermodynamics, system, surrounding and boundary, types of system, properties of system, state, equilibrium and process, types of thermodynamic processes, laws of thermodynamics- zeroth, First, second and third law.

Unit– V Electromagnetic waves: Definition, generation of electromagnetic waves and their properties. Electromagnetic spectrum: Definition, classification and its applications. Lasers: Principle and listing the types of Laser, properties of Laser, applications. Nano-Technology: Definition of Nano-Technology, advantages and dis-advantages of nano Technology.

Course outcomes: After completing this course, student will be able to:

1. Identify the force systems for given conditions by applying the basics of mechanics.
2. Create knowledge of properties of matter applicable to engineering.
3. Analyse the different concepts of waves and vibration in the field of engineering
4. Analyse the recent trends in physics related to engineering.

Reference Books: -

1. D.S. Bedi, Engineering Mechanics, Khanna Publications, New Delhi (2008)
2. Khurmi, R.S., Applied Mechanics, S. Chand & Co. New Delhi.
3. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.
4. Ramamrutham, Engineering Mechanics, S. Chand & Co. New Delhi.

EMPLOYABILITY SKILLS

Semester -2nd
Stream– B.Voc
L T P Total Credits
3 0 0 3

Sessional – 25 Marks
Theory – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

- 1) To discuss types of communication and their forms.
- 2) To improve employability skills.
- 3) To improve spoken English and ability to articulate ideas
- 4) To improve entrepreneurship skills.

Course Contents:

Unit 01 Communication skill, Oral and written communication Listening skills, written communications, motivation, ethics, Time management, facing job interviews, behaviour skills, Assessing oneself.

Unit -02 English Literacy – Pronunciation, listening speaking and reading: - greetings and introductions describing people, Telephone skills, Office Hospitality, Describing things.

Unit -03 Entrepreneurship skills- 1: - Scope and advantage of self-employment, Entrepreneurial skills, values and attitudes, Characteristics of Successful Entrepreneurs, Identification of entrepreneurs by self-assessment, Micro, small and medium enterprises, Creativity and idea generation.

Unit -04 Entrepreneurship Skills – 2: - Understanding Consumer, Market Survey: Scope & Influence of publicity and advertisement, Accounting and analysis, Assistance provided by Central and State Govt. Organizations, Project formation, feasibility and profitability estimates, Filling up a Preliminary Project Report Proforma, Investment procedure-loan procurement.

Course Outcome:

1. To learn about communication process and ways to make communication effective by giving attention to all elements involved.
2. To improve grammar and gain confidence by enhancing their abilities to articulate their ideas.
3. To acquire better writing skills in formal communication.
4. To be able to revise documents for fruitful reading and comprehension.

Reference Reading:

- 1) Wren and Martin. *High School English Grammar and Composition*. New Delhi: RRP, 2007
- 2) Murphy, Raymond. *Essential English Grammar*. New Delhi: Cambridge, 2017
- 3) Malhotra, Prerna and Halder, Deb. *Communication Skills: Theory and Practice*

WORKSHOP –II

(Covering all the practicals of ASC/Q3505)

Semester -1st
Stream– Manufacturing
L T P Total Credits
0 0 18 18

Internal – 20 Marks
External – 30 Marks
Total: 50 Marks
Duration of Exam: 3 Hours

Course objective:

- 1) To understand the safety measures of mechanical workshop.
- 2) To learn the functions of various conventional machines and unconventional machines.
- 3) To prepare different jobs by different machining operation.
- 4) To learn about CNC machine.

Course contents:

A) To Conduct all pre- machining operations:

1. Measure and mark reference points/ cutting lines on the work pieces, using compasses, callipers, rulers and other measuring tools
2. Understand the does and don'ts of the manufacturing process as defined in SOPs/ Work Instructions
3. Set of machine stops or guides as per the specified lengths indicated through scales or work instructions
4. Set-up, adjust machine tools, fixtures/ jigs and cutting tools in order to perform machining operations
5. Check the centering and facing of the work pieces and check for alignment of the work pieces as per the final product output specifications
6. Gain knowledge on gear changing techniques and minor maintenance as per checklist
7. Check the working of different holding fixtures, gears, stops.
8. Brush or spray lubricating material on work pieces where applicable
9. Operate hand wheels or valves in order to feed the component and allow cooling and lubricating to the tool.

B) To Conduct all machining operations:

1. To perform exercise on centre lathe such as facing, plain turning, step turning, chamfering and thread cutting operations.
2. To perform reaming, parting off and knurling operation by using lathe.
3. To perform the drilling and boring operations by using lathe machine.

4. To perform shaping operation of given mild steel rod.
5. To prepare a job by machining on milling machine.
6. To Prepare a 'V' block on a rectangular block on shaping machine.
7. To grind the single point cutting tool with the given nomenclature and measure angles using tool maker's microscope.
8. To perform exercise on shaping machine to obtain flat surfaces and key way.
9. To prepare a job by using planar, shaper and slotting machine.
10. To perform the operations such as drilling, counter boring and tapping using drilling machine.
11. To make a slot on the given work piece.
12. To prepare a job by surface grinding on surface grinder and perform dressing and balancing of wheels.
13. To study and use broaching machine in different applications.
14. To study a progressive tool and perform blanking and piercing.
15. To make rod/pipe bending using Hydraulic press (or) to perform Bending Operation.

C). To conduct all post machining operations:

1. Use files, hand grinders, wire brushes, or power tools for performing de burring operations.
2. Use chisels, scrapers, and other hand tools and equipment to Trim, scrape, or de burr objects or parts
3. Clean the hydraulic tank/ Gauge/ Tools/ Fixtures as per the cleaning schedule and the process mentioned in the Work Instruction/ SOP manual
4. Perform minor repairs and adjustments to the machine and notify supervisor/maintenance team when major service/ repair is required
5. Measure the specifications of the finished component and verify conformance as per Control Plan/ Work Instruction
6. Use devices like micrometers, vernier calipers, gauges, rulers and any other inspection equipment for measuring specifications with valid calibration status.
7. Note down the observations of the basic inspection process and identify pieces which comply with the specified standards
8. Organize changing different worn out machine accessories
9. Ensure that the blunt tool is timely and safely replaced by a new tool

10. Replace machine part as per work instructions, using hand tools or notify supervisor/ engineering personnel for taking corrective actions
11. Ensure that the zero offset value is chosen at the time of tool changing process.

D). To maintain 5S at the work premises:

1. Ensure the work area, tools, equipment and materials are clean
2. Carry out storage of cleaning material and equipment in the correct location and in good condition
3. Ensure self-cleanliness - clean uniform, clean shoes, clean gloves,
4. Follow the daily cleaning standards and schedules to create a clean working environment
5. Carry out sorting of materials, tools and equipment's and spare parts
6. Follow proper labeling procedures
7. Follow proper storage procedures
8. Carry out segregation of waste into Hazardous and Non Hazardous waste and dispose the waste as per SOP
9. Follow the floor markings/ area markings used for demarcating the various sections in the plant
10. Follow 5S at workplace.

Course Outcomes: After studying this course the students will be able to:

1. Understand the safety measures of mechanical workshop.
2. Perform the operations on various conventional machines and unconventional machines.
3. Prepare different jobs by different machining operation.
4. Learn about CNC machine.

Reference books:

1. A course in workshop technology: manufacturing processes by B.S. Raghuwanshi.
2. Textbook of workshop technology by R S Khurmi and J k gupta.
3. Workshop Technology Vol I & II –Hazra & Chaudhary, Asian Book Comp., New Delhi.

THIRD SEMESTER

MACHINING AND MACHINE TOOLS

Semester -3rd
Stream– B.Voc (M)
L T P Total Credits
3 0 0 3

Sessional – 25 Marks
Theory – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course objectives:

- 1) To study the various machine tools.
- 2) To understand the working of lathe machine.
- 3) To understand operations of shaping, planing and slotting machines.
- 4) To introduce about NC and CNC machines.

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: Difference between jigs and fixtures, Principle of location. Principle of clamping, Locating and clamping devices, Types of jigs & fixtures,
AUTOMATION OF MACHINE TOOLS: Introduction to CNC lathe (Computer Numerical Control Lathe) and FMS (Flexible Manufacturing System) Introduction only.

Course Outcomes:

- 1) Students will able to differentiate between various machining tools.
- 2) Students will able to perform lathe, milling and shaping machines.
- 3) Students will learn about different machining operation.
- 4) Students will understand about NC and CNC machines.

Reference books:

- 1) Manufacturing technology by P. N. Rao
- 2) Production technology- R. K. Jain
- 3) Manufacturing Science- Amitabha Ghosh & Ashok Kumar Malik, - East- West Press.
- 4) Workshop Technology Vol I & II –Hazra & Chaudhary, Asian Book Comp., New Delhi.

MATERIAL SCIENCE

Semester -3rd
Stream– B.Voc (M)
L T P Total Credits
3 0 0 3

Sessional – 25 Marks
Theory – 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course objectives:

1. To study the materials structure and their deformation.
2. To understand the ferrous metals.
3. To understand about non metallic materials.
4. To introduce about heat treatment.

GENERAL: Brief introduction to the subject metallurgy 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

UNIT-1: 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.

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

(a) 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

(b) Paints, Enamels, Varnishes and Lacquers: Paints and Enamels-types, its purpose, essential ingredients and their role, characteristics of a good paints and enamel, trade names of some important types of products. Varnishes-types purpose of varnish, essential ingredients and their role, characteristics, preparation, trade names storage of varnish, Lacquer- characteristics, preparation and uses

UNIT 4: NON-METALIC MATERIALS

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 5: 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

Course Outcomes:

- 1) Students will be able to differentiate between various ferrous and non ferrous materials.
- 2) Students will be able to understand about structure of materials.
- 3) Students will learn about non metallic materials.
- 4) Students will understand about heat treatment of materials.

Reference books:

- 1) Manufacturing technology by P. N. Rao
- 2) Production technology- R. K. Jain
- 3) Manufacturing Science- Amitabha Ghosh & Ashok Kumar Malik, - East- West Press.
- 4) Workshop Technology Vol I & II –Hazra & Chaudhary, Asian Book Comp., New Delhi.

IT TOOLS

Semester -3rd	Sessional – 25 Marks
Stream– B.Voc (A)	Theory – 75 Marks
L T P Total Credits	Total: 100 Marks
3 0 0 3	Duration of Exam: 3 Hours

Unit 1: Computer Organization & OS: User perspective.

- Understanding of Hardware.

- Basics of Operating System.

Unit 2: Networking and Internet.

- Network Safety concerns.

- Network Security tools and services.

- Cyber Security.

- Safe practices on Social networking.

Unit 3: Office automation tools:

- Spreadsheet.

- Word processing.

- Presentation.

Unit4: Multi Media Design: (Open Source Design Tools).

☒ Interface and Drawing Tools in GIMP.

☒ Applying Filters.

☒ Creating and handling multiple layers.

☒ Using Stamping and Smudging tools.

☒ Importing pictures.

Unit 5: Troubleshooting: Hardware, Software and Networking.

☒ Commonly encountered problems.

☒ (Monitor: No display, KB/Mouse not responding, monitor giving beeps, printer not responding, check for virus, Delete temporary files if system is slow, adjust mouse speed).

Work Integrated Learning IT – ISM

☒ Identification of Work Areas.

☒ Work Experience.

Reference Books:

1. IT Tools, R.K. Jain, Khanna Publishing House

2. Information Security & Cyber Laws, Sarika Gupta, Khanna Publishing House

3. Mastering PC Hardware & Networking, Ajit Mittal, Khanna Publishing House

SOFT SKILLS

Semester -3rd

Stream– B.Voc (AM)

L T P Total Credits

4 0 0 4

Sessional – 25 Marks

Theory – 75 Marks

Total: 100 Marks

Duration of Exam: 3 Hours

Course Objectives:

- 1) To help the students in building interpersonal skills.
- 2) To develop skill to communicate clearly.
- 3) To enhance team building and time management skills.
- 4) To learn active listening and responding skills.

UNIT 1: GRAMMAR AND VOCABULARY

1.Tenses, 2. Subject–verb agreement. 3. Sentence Analysis: Simple, Compound and Complex sentences. 4. Phrases: Adjective, Adverb and Noun Phrase, 5. Clauses: Adjective, Adverb and Noun Phrase. 6. Voice, Narration, Gerund, Participle.

UNIT 2: ORAL COMMUNICATION

1. Listening Skill – Active listening, Barriers to active listening. 2. Speaking Skill-Stress patterns in English, 3. Questioning skills, 4. Barriers in Speaking 5. Reading Skill-Skimming, Scanning, Intensive reading, 6. linking devices in a text, 7. Different versions of a story/ incident.

UNIT 3: WRITING SKILLS

Letter writing, Business letters • Application letters • Covering letters • Report writing o Academic report o Business report o Technical report o Technical project report • Job Application and Resume writing

UNIT- IV: SOFT SKILLS

1. Body Language– Gesture, posture, facial expression. 2. Group Discussion– Giving up of PREP, REP Technique. 3. Presentation Skills: a. (i) How to make power point presentation b. (ii) Body language during presentation 4. Resume writing: Cover letter, career objective, Resume writing (tailor made) 5. Interview Skills: Stress Management, Answering skills.

UNIT- 5: STRESS AND TIME MANAGEMENT

Introduction • Stress In Today’s Time • Identifying The Stress Source • Signs Of Stress • Ways To Cope With Stress • Healthier Ways To Deal With Stress • Time Management • Prioritize Your Work • Smart Work • Four Ds Of Decision Taking.

REFERENCE BOOKS:

- 1) Advanced English Usage: Quirk & Greenbaum; Pearson Education.
- 2) Developing Communication Skills: Banerjee Meera & Mohan Krishna; Macmillan Publications, 1990.
- 3) Personality Development and Group Discussions by Barun K. Mitra, Oxford University Press

WORKSHOP-3

Semester -3rd
Stream– B.Voc (A/M)
L T P Total Credits
0 0 8 10

Internal – 25 Marks
External – 25 Marks
Total: 50 Marks
Duration of Exam: 3 Hours

1: INTRODUCTION TO AUTOCAD

Starting AutoCAD, AutoCAD Screen Components (Drawing Area Command Window Navigation bar Status bar), Invoking Commands in AutoCAD Keyboard (Ribbon Application

Menu Tool Palettes Menu Bar Toolbar), Shortcut Menu, AutoCAD Dialog Boxes, Starting a New Drawing (Open a Drawing Start from Scratch Use a Template Use a Wizard, Saving Your Work, Save Drawing as Dialog box), Using the Drawing Recovery Manager to Recover Files, Closing a Drawing, Opening an Existing Drawing, Opening an Existing Drawing Using the Select File Dialog Box Opening an Existing Drawing Using the Startup Dialog Box Opening an Existing Drawing, Using the Drag and Drop Method, Quitting AutoCAD, Creating and Managing Workspaces Creating a New Workspace Modifying the Workspace Settings Autodesk Exchange

2: GETTING STARTED WITH AUTOCAD

Dynamic input mode, Enable Pointer Input, Enable Dimension Input where possible Show command prompting and command input near the crosshairs, Drafting Tooltip Appearance, Drawing Lines in autocad, The Close Option, The Undo Option, Invoking tools Using Dynamic INPUT/Command Prompt Coordinate Systems, Absolute Coordinate System, Relative Coordinate System, Relative Polar Coordinates, Direct Distance Entry Erasing Objects, Cancelling and Undoing a Command Object Selection Methods, Window Selection Window Crossing Method Drawing a Circle, BASIC Display Commands Setting Units Type and Precision, Specifying the Format Specifying the Angle Format, setting the limits of a drawing.

3: STARTING WITH ADVANCED SKETCHING

Drawing Arcs, Drawing Rectangles, Drawing Ellipses, Drawing Regular Polygon, Drawing Polylines Placing Points, Drawing Infinite Lines Writing a Single Line Text

4: WORKING WITH DRAWING AIDS

Introduction, Understanding the Concept and use of LAYERS, Advantages of Using Layers, Working with Layers, Creating New Layers, Making a Layer Current, Controlling the Display of Layers, Deleting Layers, Object Properties Changing the Colour, Changing the Line type, Changing the Line weight, Changing the Plot Style, Properties Palette, Quick Properties, Palette Drafting, Settings dialog box, Setting Grid, Setting Snap, Snap Type, Drawing Straight Lines using the Ortho Mode, Working with Object Snaps, Auto Snap, Endpoint Midpoint, Nearest Centre, Tangent Quadrant Intersection, Apparent Intersection Perpendicular, Node

Insertion, Snap to None Parallel Extension From, Midpoint between 2 Points, Temporary Tracking Point, Combining Object Snap Modes, Running Object, Snap Mode, Overriding the Running Snap, Cycling through Snaps, Using Auto Tracking, Object Snap Tracking, Polar Tracking, Auto Track Settings, Function and Control Keys.

5: EDITING SKETCHED OBJECTS-I

Editing Sketches, Moving the Sketched Objects, Copying the Sketched Objects, Creating Multiple Copies, Creating a Single Copy, Offsetting Sketched Objects, Rotating Sketched Objects, Scaling the Sketched Objects, Filleting the Sketches, Chamfering the Sketches, Trimming the Sketched Objects, Extending the Sketched Objects, Stretching the Sketched Objects, Lengthening the Sketched Objects, Arraying the Sketched Objects, Rectangular Array Polar Array, Path Array, Mirroring the Sketched objects Text Mirroring.

6: EDITING SKETCHED OBJECTS-II

Introduction to Grips Types of Grips, Editing a Polyline by Using Grips Editing Grippled Objects ,Changing the Properties Using the PROPERTIES Pale Matching the Properties of Sketched Objects, Cycling Through Selection, Managing Contents Using the Design enter Autodesk Seek design content Link Displaying Drawing Properties, Basic Display Options Redrawing the Screen Regenerating Drawings, Zooming Drawings Real-time Zooming All Option, Centre Option Extents Option Dynamic Option Previous Option Window Option Scale Option Object Option Zoom In and Out, Panning Drawings Panning in Real time.

7: CREATING TEXT AND TABLES

Annotative Objects Annotation Scale, Assigning Annotative Property and Annotation Scales Customizing Annotation Scale, Multiple Annotation Scales, Assigning Multiple Annotation Scales Manually Assigning Multiple Annotation Scales Automatically, Controlling the Display of Annotative objects Creating Text, Writing Single Line Text Entering Special Characters Creating Multiline Text, Text Window Text Editor Tab, Editing Text, Editing Text Using the DDEDITCommand Editing Text Using the Properties Palette Modifying the Scale of the Text, Inserting Table in the Drawing Table style Area, Insert options Area Insertion behaviour Area, Column and row settings Area Set cell styles Area, Creating a New Table Style Starting table

Area General Area, Cell styles Area, Setting a Table Style as Current Modifying a Table Style Modifying Tables, Substituting Fonts, Specifying an Alternate Default Font Creating Text Styles, Determining Text Height Creating Annotative text

8: BASIC DIMENSIONING, GEOMETRIC DIMENSIONING, AND TOLERANCING

Need for Dimensioning in AutoCAD Fundamental Dimensioning Terms, Dimension Line, Dimension Text Arrowheads Extension Lines Leader, Centre Mark and Centrelines Alternate Units, Tolerances Limits, Associative Dimensions Definition Points Annotative Dimensions, Selecting Dimensioning Commands Using the Ribbon and the Toolbar Using the Command Line, Dimensioning a Number of Objects Together Creating Linear Dimensions, DIMLINEAR Command Options Creating Aligned Dimensions Creating Arc Length Dimensions Creating Rotated Dimensions Creating Baseline Dimensions Creating Continued Dimensions Creating Angular Dimensions, Dimensioning the Angle between Two Nonparallel Lines Dimensioning the Angle of an Arc, Angular Dimensioning of Circles, Angular Dimensioning based on Three Points Creating Diameter Dimensions, Creating Radius Dimensions Creating Jogged Linear Dimensions Creating Ordinate Dimensions, Maintaining Equal Spacing between Dimensions Creating Inspection Dimensions, Inspection Label Dimension Value, Working with True Associative Dimensions Inspection Rate, Removing the Dimension Associatively, Converting a Dimension into a True Associative Dimension Drawing Leaders, Multileader, Adding leaders to existing Multileader, Removing Leaders from Existing Multileader, Aligning Multileaders, Distribute, Make leader segments Parallel Specify Spacing, Use current spacing, Geometric Dimensioning and Tolerance Geometric Characteristics and Symbols Adding, Geometric Tolerance, Feature Control Frame, Geometric Characteristics Symbol, Tolerance Value and Tolerance Zone Descriptor Material Condition Modifier, Datum, Complex Feature Control Frames Composite Position Tolerance Projected Tolerance Zone, Creating Annotative Dimensions, Tolerances, Leaders, and Multileaders

9: EDITING DIMENSIONS

Editing Dimensions Using Editing Tools Editing Dimensions by Stretching, Editing Dimensions by Trimming and Extending Flipping Dimension Arrow, Modifying the

Dimensions Editing the Dimension Text Updating Dimensions, Editing Dimensions with Grips, Editing Dimensions using the Properties Palette Properties Palette (Dimension), Properties Palette (Multileader), Model Space and Paper Space Dimensioning

10: DIMENSION STYLES, MULTILEADER STYLES, AND SYSTEM VARIABLES

Using Styles and Variables to Control Dimensions Creating and Restoring Dimension Styles, New Dimension Style dialog box Controlling the Dimension Text Format Fitting Dimension Text and Arrowheads Formatting Primary Dimension Units Formatting, Alternate Dimension Units Formatting the Tolerances, Creating and Restoring Multileader Styles Modify Multileader Style dialog box.

11: MODEL SPACE VIEWPORTS, PAPER SPACE VIEWPORTS, AND LAYOUTS

Model Space and Paper Space/Layouts Model Space Viewports (Tiled Viewports), Creating Tiled Viewports Making a Viewport Current Joining Two Adjacent Viewports, Paper space viewports (Floating Viewports) Creating Floating Viewports, Creating Rectangular Viewports Creating Polygonal Viewports, Converting an Existing Closed Object into a Viewport Temporary Model Space, Editing Viewports, Controlling the Display of Objects in Viewports Locking the Display of Objects in Viewports Controlling the Display of Hidden Lines in Viewports Clipping Existing Viewports, Maximizing Viewports Inserting Layouts, Inserting a Layout Using the Wizard Defining Page Settings, Controlling the Display of Annotative Objects in Viewports

12: PLOTTING DRAWINGS

Plotting Drawings in AutoCAD, Plotting Drawings Using the Plot Dialog Box Page setup Area, Printer/plotter Area Paper size Area Number of copies Area Plot area, Plot offset (origin set to printable area) Area Plot scale Area, Plot style table (pen assignments) Area Shaded viewport options Area, Plot options Area Preview, Adding Plotters, The Plotter Manager Tool Using Plot Styles, Adding a Plot Style

13: HATCHING DRAWINGS

Hatching, Hatch Patterns Hatch Boundary, Hatching Drawings Using the Hatch Tool Panels in the Hatch Creation Tab, Boundaries Panel Pattern Panel Properties Panel Origin Panel Options Panel Match Properties, Setting the Parameters for Gradient Pattern Creating Annotative Hatch, Hatching the Drawing Using the Tool Palettes Drag and Drop Method, Select and Place Method, Hatching Around Text, Dimensions, and Attributes

14: WORKING WITH BLOCKS

The Concept of Blocks Advantages of Using Blocks Drawing Objects for Blocks, Converting Entities into a Block Inserting Blocks, Creating and Inserting Annotative Blocks Block Editor, Adding Blocks in Tool Palettes Drag and Drop Method, Modifying Existing Blocks in the Tool Palettes, Layers, Colours, Line types, and Line weights for Blocks Nesting of Blocks, Creating Drawing Files using the Write Block Dialog Box Exploding Blocks Using the XPLODE Command Renaming Blocks, Deleting Unused Blocks Editing Constraints to Block.

FOURTH SEMESTER

Students will go in industries for On Job Training. Students will be evaluated based upon On Job Training (OJT)/Internship including report and presentation.

FIFTH SEMESTER

Students will go in industries for On Job Training. Students will be evaluated based upon On Job Training (OJT)/Internship including report and presentation.

SIXTH SEMESTER

QUALITY CONTROL TECHNIQUES

Semester - VI	Sessional – 25 Marks
Stream– B.Voc (AM)	Theory – 75 Marks
L T P Total Credits	Total: 100 Marks
3 0 0 3	Duration of Exam: 3 Hours

Course Objectives:

- 1) To introduce about quality control techniques.
- 2) To learn QC tools.
- 3) To understand Trends in Quality Engineering & Management.

Course Contents:

Unit I: For the complete syllabus, results, class timetable and more kindly [download iStudy](#). It's a lightweight, easy to use, no images, no pdfs platform to make student's life easier.

Unit II: Quality Engineering and Management Tools, Techniques & Standards: 7 QC tools, 7 New Quality Management Tools, 5S Technique, Kaizen, Poka-Yoke, Quality Circle, Cost of Quality Technique. Introduction to Quality Management Standards-ISO: 9000, ISO:14000, QS:9000 (Concept, Scope, Implementation Requirements & Barriers, and Benefits), Introduction to National and International Quality Awards (Malcolm Baldrige National Quality Award-MBNQA, The Deming Prize Rajiv Gandhi National Quality Award).

Unit III: Basic Philosophy, Approach, Implementation Requirements & Barriers. Designing for Quality: Introduction to Concurrent Engineering, Quality Function Deployment (QFD) and Failure Mode and Effect Analysis (FMEA)-Concept, Methodology and Application (with case studies).

Unit V: Contemporary Trends in Quality Engineering & Management: Six Sigma-Basic Concept, Principle, Methodology, Implementation, Scope, Advantages and Limitation of all as applicable. Quality in Service Sectors: Characteristics of Service Sectors, Quality Dimensions in Service Sectors, Measuring Quality in Different Service Sectors.

Books and References:

1. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India.
2. Quality Management by Kanishka Bedi.
3. Statistical Quality Control by M. Mahajan, Dhanpat Rai & Co. (P) Ltd.

INDUSTRIAL MANAGEMENT

Semester - VI	Sessional – 25 Marks
Stream– Automobile	Theory – 75 Marks
L T P Total Credits	Total: 100 Marks
3 0 0 3	Duration of Exam: 3 Hours

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.

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.

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.

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.

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 Management, S.C. Sharma, Khanna Publishing House

ENTREPRENEURSHIP

Semester - VI	Sessional – 25 Marks
Stream– Automobile	Theory – 75 Marks
L T P Total Credits	Total: 100 Marks
3 0 0 3	Duration of Exam: 3 Hours

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

2. Entrepreneurial Development: Product identification/ selection, Site selection, Plant layout,

Institutional support needed, Pre-market survey.

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.

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

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

RELIABILITY, MAINTENANCE & SAFETY **ENGINEERING***

Semester - VI	Sessional – 25 Marks
Stream– B.Voc (AM)	Theory – 75 Marks
L T P Total Credits	Total: 100 Marks
3 0 0 3	Duration of Exam: 3 Hours

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

PLANT LAYOUT & PRODUCT HANDLING*

Semester - VI	Sessional – 25 Marks
Stream– B.Voc (AM)	Theory – 75 Marks
L T P Total Credits	Total: 100 Marks
3 0 0 3	Duration of Exam: 3 Hours

Course objectives:

1. To learn Objective of Facility Design.
 2. To study Computerized handling of layout algorithms.
 3. To study Product handling.
1. 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.
 2. 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.
 3. 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;
 4. 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.
 5. Application of pneumatic and hydraulic system in transportation and handling of products, Design of integrated plant layout for product handling systems

CAD & CAM*

Semester - VI	Sessional – 25 Marks
Stream– B.Voc (M)	Theory – 75 Marks
L T P Total Credits	Total: 100 Marks
3 0 0 3	Duration of Exam: 3 Hours

Course objectives:

1. To study about Introduction CIM and CAD & Analysis.
 2. To study about Computer aided Manufacturing CAM.
 3. To study about Part Programming NC part programming
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

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)

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.

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.

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.

PROJECT

Students needs to do a project in this semester.

WORKSHOP – VI

(Covering all the practicals of Supervisor Manufacturing (ASC/Q6306))

Semester -1st

Internal – 20 Marks

Stream– Manufacturing

External – 30 Marks

L T P Total Credits

Total: 50 Marks

0 0 18 18

Duration of Exam: 3 Hours

Course objective:

1. To understand the safety measures of mechanical workshop.
2. To learn the functions of various conventional machines and unconventional machines.
3. To prepare different jobs by different machining operation.
4. To learn about CNC machine.

Course contents:

1. Measure and mark reference points/ cutting lines on the work pieces, using compasses, callipers, rulers and other measuring tools
2. Understand the does and don'ts of the manufacturing process as defined in SOPs/ Work Instructions
3. Set of machine stops or guides as per the specified lengths indicated through scales or work instructions
4. Set-up, adjust machine tools, fixtures/ jigs and cutting tools in order to perform machining operations
5. Check the centering and facing of the work pieces and check for alignment of the work pieces as per the final product output specifications
6. Gain knowledge on gear changing techniques and minor maintenance as per checklist
7. Check the working of different holding fixtures, gears, stops.
8. Brush or spray lubricating material on work pieces where applicable
9. Operate hand wheels or valves in order to feed the component and allow cooling and lubricating to the tool.
10. To perform exercise on centre lathe such as facing, plain turning, step turning, chamfering and thread cutting operations.
11. To perform reaming, parting off and knurling operation by using lathe.
12. To perform the drilling and boring operations by using lathe machine.
13. To perform shaping operation of given mild steel rod.
14. To prepare a job by machining on milling machine.
15. To Prepare a 'V' block on a rectangular block on shaping machine.
16. To grind the single point cutting tool with the given nomenclature and measure angles using tool maker's microscope.
17. To perform exercise on shaping machine to obtain flat surfaces and key way.
18. To prepare a job by using planar, shaper and slotting machine.
19. To perform the operations such as drilling, counter boring and tapping using drilling machine.
20. To make a slot on the given work piece.
21. To prepare a job by surface grinding on surface grinder and perform dressing and balancing of wheels.
22. To study and use broaching machine in different applications.

23. To study a progressive tool and perform blanking and piercing.
24. To make rod/pipe bending using Hydraulic press (or) to perform Bending Operation.
25. Use files, hand grinders, wire brushes, or power tools for performing de burring operations.
26. Use chisels, scrapers, and other hand tools and equipment to Trim, scrape, or de burr objects or parts
27. Clean the hydraulic tank/ Gauge/ Tools/ Fixtures as per the cleaning schedule and the process mentioned in the Work Instruction/ SOP manual
28. Perform minor repairs and adjustments to the machine and notify supervisor/maintenance team when major service/ repair is required
29. Measure the specifications of the finished component and verify conformance as per Control Plan/ Work Instruction
30. Use devices like micrometers, vernier calipers, gauges, rulers and any other inspection equipment for measuring specifications with valid calibration status.
31. Note down the observations of the basic inspection process and identify pieces which comply with the specified standards
32. Organize changing different worn out machine accessories
33. Ensure that the blunt tool is timely and safely replaced by a new tool
34. Replace machine part as per work instructions, using hand tools or notify supervisor/ engineering personnel for taking corrective actions

Course Outcomes: After studying this course the students will be able to:

1. Understand the safety measures of mechanical workshop.
2. Perform the operations on various conventional machines and unconventional machines.
3. Prepare different jobs by different machining operation.
4. Learn about CNC machine.

Reference books:

- 1) A course in workshop technology: manufacturing processes by B.S. Raghuvanshi.
- 2) Textbook of workshop technology by R S Khurmi and J k gupta.
- 3) Workshop Technology Vol I & II –Hazra & Chaudhary, Asian Book Comp., New Delhi.



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(Established by Haryana State Legislative Act No. 21 of 2009 & Recognized by UGC Act 1956 u/s 22 to Confer Degrees)

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COMMUNITY COLLEGE OF SKILL DEVELOPMENT (CCSD)



ANNEXURE-1A

Program B.Voc Manufacturing (program Code: 252)

Revised Scheme Course Index of the year 2020-2021(BOS Dated 18/05/2020)

Mapping of the course with the employability/Entrepreneurship/Skill Development

S.NO	Course	Code	Skill development	Entrepreneurship	Employability
1	Communication Skills	BSC-101	✓	✓	
2	Engineering Calculations	BSC-102	✓	✓	
3	Engineering Science	PCC-AM-106	✓		✓
4	Manufacturing process-1	PCC-AM-101	✓		✓
5	Manufacturing Workshop-1	PCC-AM-103	✓	✓	✓
6	Employability Skills - 1	BSC-206	✓	✓	
7	Applied Science	PCC-AM-205	✓		✓
8	Quality, inspection and Safety	PCC-AM-202	✓		✓
9	Manufacturing process-2	PCC-AM-201	✓		✓
10	Manufacturing Workshop-2	PCC-AM-204	✓	✓	✓
11	Machining and Machine Tools		✓		✓
12	Material Science	PCC-AM-302	✓		✓
13	IT TOOLS	PCC-AM-306	✓		✓
14	Soft Skills	BSC-301	✓	✓	
15	Manufacturing Workshop-3	PCC-AM-305	✓	✓	✓
16	ON-JOB TRAINING	PCC-AM-401	✓	✓	✓
17	ON-JOB TRAINING	PCC-AM-501	✓	✓	✓
18	Quality Control Techniques	PCC-M-604	✓		✓
19	Industrial Management	PCC-AM-603	✓		✓
20	Entrepreneurship	BSC-601	✓		✓
21	Project	BSC-602	✓	✓	
22	Manufacturing Workshop-4	PCC-M-606	✓	✓	✓
23	Reliability, Maintenance & Safety Engineering*	PCC-M-605	✓		✓
24	Plant Layout & Product Handling*	PCC-M-607	✓		✓
25	CAD & CAM*	PCC-M-608	✓		✓

Principal, CCSD