SCHEME & SYLLABI

for

BACHELOR OF VOCATION

In

MECHANICAL ENGINEERING

(MANUFACTURING ENGINEERING)

(w.e.f. session 2026-2027)

(As per NEP 2020 & UGC Curriculum and Credit Framework for Undergraduate Programmes – CCFUP)

(Choice Based Credit System with Multiple Entry & Exit and NSQF/NCrF Alignment)

COMMUNITY COLLEGE OF SKILL DEVELOPMENT

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
SECTOR-6, FARIDABAD, HARYANA-121006

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

(formerly YMCA University of Science and Technology)
A State Govt. University established vide State Legislative Act No. 21 of 2009
SECTOR-6, FARIDABAD, HARYANA-121006

VISION

"J.C. Bose University of Science and Technology, YMCA, Faridabad aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building."

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the-art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

Community College of Skill Development (CCSD)

VISION

"To be a centre of excellence in vocational and skill-based higher education that produces competent, self-reliant and industry-ready professionals with sound technical skills, ethical values and a spirit of innovation and lifelong learning."

MISSION

- To impart quality vocational education integrating theory, hands-on practice and on-the-job training aligned with NSQF/NCrF and industry standards.
- To strengthen employability and entrepreneurship through competency-based, outcome-oriented and skill-intensive curricula.
- To foster multiple entry and exit pathways that empower learners to progress seamlessly across academic and vocational qualifications.

ABOUT THE COMMUNITY COLLEGE OF SKILL DEVELOPMENT (CCSD)

The Community College of Skill Development (CCSD) at J.C. Bose University of Science and Technology, YMCA, Faridabad, was established to advance the national skill-development agenda through industry-aligned, competency-based vocational education under the National Skills Qualifications Framework (NSQF) and the National Credit Framework (NCrF). CCSD offers Bachelor of Vocation (B.Voc.), Diploma and Post-Graduate Diploma programmes that blend academic rigour with extensive practical training, workshops and on-the-job training (OJT) in partnership with industry and Sector Skill Councils.

ABOUT THE PROGRAMME

The B.Voc. Mechanical Engineering (Manufacturing Engineering) programme is designed in accordance with NEP 2020 and the UGC Curriculum and Credit Framework for Undergraduate Programmes (CCFUP), incorporating a flexible, choice-based credit system, multidisciplinary courses, and multiple entry and exit options, with appropriate NSQF/NCrF-aligned certifications at each year of study. The programme leverages the University's state-of-the-art laboratories, manufacturing workshops, CNC and CAD/CAM facilities, robotics and automation labs, and its strong industry linkages to ensure that every graduate is industry-ready and employable at progressively higher levels of competency.

TABLE 1 PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1	To equip students with strong practical and hands-on vocational skills in core and applied areas of mechanical and manufacturing engineering to make them industry-ready and employable.
PEO2	To develop the ability to operate, set up, maintain and improve machines, tools and manufacturing processes useful to industry and society.
PEO3	To inculcate teamwork, communication, leadership and entrepreneurial skills with high regard for ethical values, safety and social responsibility.
PEO4	To foster a mindset of lifelong learning, adaptability to emerging technologies and seamless academic-vocational progression through multiple entry and exit pathways.

TABLE 2 PROGRAMME OUTCOMES (POs)

PO1	Vocational & Technical Skills: Apply practical, professional and procedural knowledge to perform skilled manufacturing and mechanical tasks in routine and non-routine contexts.
PO2	Problem Solving: Identify, analyse and solve well-defined technical problems on the shop floor using appropriate tools, techniques and engineering fundamentals.
PO3	Modern Tool Usage: Select and apply modern equipment, CAD/CAM, CNC, measurement and manufacturing tools and IT resources to accomplish vocational tasks.
PO4	Quality, Safety & Environment: Follow quality standards, occupational health and safety practices and environmentally responsible methods at the workplace.
PO5	Communication & Teamwork: Communicate effectively, document work, and function efficiently as an individual and as a member of multidisciplinary teams.
PO6	Ethics & Professional Conduct: Practise professional ethics, constitutional and human values, and demonstrate accountability and integrity in work and learning.
PO7	Entrepreneurship & Management: Apply basic management, costing and entrepreneurial principles to plan, organise and manage vocational activities and small enterprises.
PO8	Lifelong Learning & Employability: Engage in self-directed and lifelong learning, adapt to emerging technologies, and progress across NSQF/NCrF qualification levels.

TABLE 3 PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1	Ability to apply practical knowledge and manufacturing skills (machining, CNC/CAM, tool & die, fitting and fabrication) in the profession.
PSO2	Ability to design, plan and supervise manufacturing processes, maintaining high standards of quality, safety, ethics and social well-being.

TABLE 4 SUSTAINABLE DEVELOPMENT GOALS (SDGs) ADDRESSED

SDG 4	Quality Education — inclusive, equitable quality education and lifelong learning.
SDG 8	Decent Work and Economic Growth — productive employment and decent work for all.
SDG 9	Industry, Innovation and Infrastructure — resilient infrastructure and sustainable industrialisation.
SDG 12	Responsible Consumption and Production — sustainable production patterns.
SDG 13	Climate Action — combating climate change through sustainable practices.

TABLE 5 COURSE CODES AND DEFINITIONS (UGC CCFUP CATEGORIES)

L	Lecture
T	Tutorial
P	Practical
DSC	Discipline Specific Course (core vocational/technical)
DSC Lab	Discipline Specific Laboratory / Workshop
MDC	Multidisciplinary Course
AEC	Ability Enhancement Course (language & communication)
VAC	Value Added Course
SEC	Skill Enhancement Course
OJT	On-Job Training / Industrial Training
Project	Project / Field Work
MOOC	Massive Open Online Course (SWAYAM/NPTEL)

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
COMMUNITY COLLEGE OF SKILL DEVELOPMENT (CCSD)
SCHEME OF STUDIES & EXAMINATIONS
THREE-YEAR BACHELOR OF VOCATION (B.Voc.) PROGRAMME IN
MECHANICAL ENGINEERING (MANUFACTURING ENGINEERING)
SEMESTER I – VI (w.e.f. Session 2026-27) (As per NEP 2020 & UGC CCFUP)

TABLE 6
Semester Wise Credit Distribution

Semester	DSC	AEC	MDC	VAC	SEC	Project	Total
I	14		3	3			20
II	13	4		3			20
III	18		2				20
IV	15		3			2	20
V					20		20
VI					20		20
Total Credits	60	4	8	6	40	2	120

Note:

a) A student has to earn at least 3 credits during the duration of the degree by passing at least one MOOC course of a minimum 12-week duration (carrying at least 3 credits) through the SWAYAM / NPTEL platform.

b) A student has to earn 1 credit for the Tree Plantation Activity.

MANDATORY INDUCTION PROGRAMME

When new students enter the institution, they bring diverse thoughts, backgrounds, and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of a larger purpose. A mandatory Induction Programme for the B.Voc. students entering the institution shall be conducted right at the start. Normal classes will begin only after the Induction Programme is over. There is no fixed time limit prescribed for the programme; its duration may be decided by the College/Department as appropriate. Its purpose is to make students feel comfortable in their new environment, open them up, establish a healthy daily routine, foster bonding within the batch as well as between faculty and students, and develop awareness, sensitivity, and understanding of the self, the people around them, society at large, and nature.

Tentative activities which may be planned in this Induction Programme are as follows:

- Physical Activity
- Creative Arts
- Universal Human Values
- Literary Activities
- Proficiency Modules
- Lectures by Eminent People

- Visits to Local Area / Industry
- Familiarisation with the College / Trade & Innovations

GUIDELINES FOR TREE PLANTATION AND CARE

As approved in the Academic Council, Tree Plantation is a mandatory activity for every student admitted to J. C. Bose University of Science and Technology, YMCA, Faridabad.

Instructions for Students:

1. **Tree Plantation:** Each admitted student is required to plant at least 2-5 tree saplings during his/her first or second semester at any place of their choice at/near their home (e.g., parks, grounds, etc.). The student must capture geo-tagged photographs of the planted saplings (with the student in the photo) and properly care for them as they grow.
2. **Submission of Documents:** The student has to submit geo-tagged photographs of the planted saplings on the University ERP platform in the prescribed format, including the name of the plant, date of plantation and any additional information.
3. **Ongoing Care and Monitoring:** After planting, every student will take care of these plants and submit updated geo-tagged photos for subsequent years. The plantation document will be submitted once every year for (N-1) times, where N is the total duration of the programme. For example, a student of a 3-year B.Voc. programme has to submit the plantation document for two consecutive years, i.e., up to the pre-final year, indicating the growth and survival of the sapling.
4. **Tree Survival:** The student must ensure the successful survival of at least one tree out of the 2-5 initially planted to be eligible for the degree.
5. **Verification of Documents:** Verification will be done by the respective teacher-coordinator at each successive year during Practical Examinations towards the end of the semester, as per the notified academic calendar.
6. **Certificate of Achievement:** The certificate for an eligible student will be auto-generated and may be downloaded from the ERP platform after due verification, fulfilling the requirement for degree conferral.

EXIT CRITERIA

For J. C. Bose University of Science and Technology, YMCA, under the NEP 2020 and UGC CCFUP framework, the exit criteria generally require students to secure a minimum of 40% marks in the end-term examinations, in accordance with the University Examination Ordinance. In addition, students must fulfil the prescribed overall credit requirements to be eligible for the different exit options — UG Certificate, UG Diploma or B.Voc. Degree — aligned with the multiple entry and exit provisions of the National Education Policy, the National Skills Qualifications Framework (NSQF) / National Credit Framework (NCrF), and the guidelines of the University Grants Commission. Each year of study is mapped to a corresponding NSQF level:

Year 1 → NSQF 4.5, Year 2 → NSQF 5.0, and Year 3 → NSQF 5.5.

TABLE 7

EXIT OPTION DETAILS

S. No.	NSQF Level	Semester	Exit Options	Credits	Additional Credits for Exit	List of Exit Courses
1.	4.5	Sem I & II	U.G. Certificate (Mechanical Engineering (Manufacturing Engineering))	40	4	Minimum 4–6 weeks of Industrial Internship OR online discipline-specific skill courses at the relevant NCRF/NSQF level from NSQF/SSC/SWAYAM/NPTEL/any other recognised certifying agency (comprising either two courses of 2 credits each or one course of 4 credits) OR a Technical Project.
2.	5.0	Sem III & IV	U.G. Diploma (Mechanical Engineering (Manufacturing Engineering))	40	4	Minimum 4–6 weeks of Industrial Internship OR online discipline-specific skill courses at the relevant NCRF/NSQF level from NSQF/SSC/SWAYAM/NPTEL/any other recognised certifying agency (comprising either two courses of 2 credits each or one course of 4 credits) OR a Technical Project.

Exit Option for U.G. Certificate (Level 4.5): Any student opting for exit after the second semester will get a UG Certificate provided he/she earns 40 credits in the first two semesters and an additional 4 credits based on the exit options as per Table 7. Thus, he/she will be eligible to exit with 44 credits. The Internship Report / Certificate Course / Technical Project would be evaluated by an approved panel of experts.

EMPLOYMENT PATHWAYS AFTER EXIT	
Exit Qualification	U.G. Certificate
NSQF / NCrF Level	4.5
Associated Industry Sectors	Manufacturing, Capital Goods, Automotive, Tool & Die, CNC Machining, Maintenance, Design.
Mapped Job Roles	Mechanical Assistant, CNC Operator/Setter, Mechanical Fitter, Welder/Fabricator, Sheet-Metal Worker, Tool Room Assistant, Machine Shop Assistant, Maintenance Assistant, AC/Refrigeration Assistant, Support Staff in Stores/Logistics/Production Planning.
Further Progression	Possibility of re-entry into higher semesters through the Academic Bank of Credits (ABC).

Exit Option for U.G. Diploma (Level 5.0): Any student opting for exit after the fourth semester will get a UG Diploma provided he/she earns 40 credits of Semesters I & II, 40 credits of Semesters III & IV, and an additional 4 credits based on the exit options as per Table 7. Thus, he/she will be eligible to exit with 84

credits. The Internship Report / Certificate Course / Technical Project would be evaluated by an approved panel of experts.

EMPLOYMENT PATHWAYS AFTER EXIT	
Exit Qualification	U.G. Diploma
NSQF / NCrF Level	5.0
Associated Industry Sectors	Manufacturing, Capital Goods, Automotive, Tool & Die, CNC Machining, Maintenance, Design.
Mapped Job Roles	Mechanical Draughtsman/CAD Operator, CNC Operator-cum-Programmer, Tool & Die Maker, Junior Designer (Mechanical), Production/Manufacturing Technician, Production Planning Assistant, Quality Inspector, Mechatronics Technician, Process Technician.
Further Progression	Possibility of re-entry into higher semesters through the Academic Bank of Credits (ABC).

Criteria for B.Voc. Degree (Level 5.5): A student completing all six semesters will be awarded the B.Voc. Degree on earning 40 credits of Semesters I & II, 40 credits of Semesters III & IV, and 40 credits of Semesters V & VI (Industrial Training / OJT), subject to the MOOC and Tree-Plantation requirements.

EMPLOYMENT PATHWAYS AFTER EXIT	
Exit Qualification	B.Voc. Degree
NSQF / NCrF Level	5.5
Associated Industry Sectors	Manufacturing, Capital Goods, Automotive, Tool & Die, CNC Machining, Maintenance, Design.
Mapped Job Roles	Production Supervisor, Senior Manufacturing Technician, Machine Shop Supervisor, Welding/Fabrication Shop Supervisor, Quality Control Inspector, Tool Designer, Junior Design Engineer, Rapid Prototyping Supervisor, Automation Support Officer, Continuous Improvement Officer, Low-Cost Automation Engineer.
Further Progression	Possibility of progression to higher studies through the Academic Bank of Credits (ABC).

NSQF JOB-ROLE & NATIONAL OCCUPATIONAL STANDARDS (NOS) ALIGNMENT

This section maps each year-end NSQF exit point of the B.Voc. Mechanical Engineering (Manufacturing Engineering) programme to the appropriate Qualification Pack (QP) / Job Role and aligns the relevant National Occupational Standards (NOS) to specific subjects of the scheme, with brief justifications.

Year 1 → NSQF 4.5, Year 2 → NSQF 5.0, Year 3 → NSQF 5.5.

Year-wise NSQF Alignment (Summary)

Exit Year	NSQF Level	Job Role	QP Code / NQR	Sector / Council	NOS Aligned
Year 1 (Sem I & II)	4.5	Mechanical Engineering CAD	CSC/Q0419	Capital Goods – Design (CGSSC)	7 NOS
Year 2 (Sem III & IV)	5.0	Jr. Designer (Mechanical)	CSC/Q0405	Capital Goods – Fitter Design (CGSSC)	7 NOS
Year 2 (Sem III & IV)	5.0	Tool and Die Maker	CSC/Q0306	Capital Goods – Fitting & Assembly (CGSSC)	7 NOS
Year 3 (Sem V & VI)	5.5	Low-Cost Automation Engineer (Production Engineering)	ASC/N6464	Automotive Skills Development Council (ASDC)	7 NOS

YEAR 1 EXIT — NSQF Level 4.5 (Semesters I & II)

Job Role: Mechanical Engineering CAD
QP Code: CSC/Q0419 NQR / Ref: QG-4.5-CG-01808-2024-V1-CGSC Occupation: Design Sector: Capital Goods (CGSSC)

NOS – Course Alignmnet

NOS Code	NOS Title	Aligned Course (s)	Justification (Brief)
CSC/N0451	Technical Drawing and Measuring	Computer Aided Design Lab–I & II	Builds technical drawing, dimensioning and 2D/3D drafting skills required by this NOS.
CSC/N0448	Perform 3D Modelling	Computer Aided Design Lab–I & II	CAD labs introduce 3D solid modelling and proficiency with software.
CSC/N0447	Materials, Software and Hardware	Engineering Materials & Manufacturing Processes	Covers material properties, selection criteria and manufacturing methods.
CSC/N0449	Create 2D Rendered Images & Animations	Computer Aided Design Lab–II	CAD rendering and visualisation exercises develop 2D presentation competency.
CSC/N0459	Work Organisation and Management	Professional Communication Skills; Workshop Calculations & Analytical Techniques	Communication and analytical tools support workplace organisation and documentation.
CSC/N0450	Reverse Engineering of Physical Models	Manufacturing Workshop–I & II; Engineering Mechanics & SoM	Workshop measuring, fitting, and assembly enable reverse engineering of components.
DGT/VSQ/N0102	Employability Skills	Professional Communication Skills	Communication, numeracy and professional skills fulfil employability requirements.

YEAR 2 EXIT — NSQF Level 5.0 (Semesters III & IV) — Job Role A

Job Role: Jr. Designer (Mechanical)
QP Code: CSC/Q0405 NQR / Ref: QG-05-CG-03929-2025-V2-CGSSC Occupation: Fitter – Design Sector: Capital Goods (CGSSC)

NOS — Course Alignment

NOS Code	NOS Title	Aligned Course (s)	Justification (Brief)
CSC/N1335	Follow Health & Safety Practices at Work	CNC Machining Lab–I & II; IC Engines & Machine Maintenance Workshop	Lab-based safety drills align directly with workplace H&S NOS.
CSC/N1336	Coordinate with Co-workers for Work Efficiency	Industrial Engineering & Production Management	Teaches teamwork in production planning, lean methods and quality improvement.
CSC/N0405	Determine Client Requirement & Create a Design Brief	Tool & Die Design	Design brief creation for jigs, fixtures and press tools mirrors this NOS.
CSC/N0402	Create & Modify Mechanical Drawings (CAD/CAM)	CNC Technology & CAM; CNC Machining Lab–I & II	CAM labs produce, edit and simulate tool paths — core competency.
CSC/N0408	Create & Modify 3D Mechanical Models (CAD/CAM)	Computer Aided Design Lab–I & II	CAD/CAM modelling develops advanced 3D modelling and simulation skills.
CSC/N0407	Develop Prototypes using a 3D Printer	Tool & Die Design; Project	The project involves designing and fabricating prototypes.
DGT/VSQ/N0102	Employability Skills	Professional Communication Skills; Computer Applications & Data Visualisation	Communication and data tools reinforce employability at a higher complexity.

YEAR 2 EXIT — NSQF Level 5.0 (Continued) — Job Role B

Job Role: Tool and Die Maker
QP Code: CSC/Q0306
NQR / Ref: QG-05-CG-03947-2025-V2-CGSSC
Occupation: Fitting & Assembly
Sector: Capital Goods (CGSSC)

NOS - Course Alignment

NOS Code	NOS Title	Aligned Subject(s)	Justification (Brief)
CSC/N1335	Follow Health & Safety Practices at Work	IC Engines & Machine Maintenance Workshop; CNC Machining Lab–I & II	Machine-shop safety protocols fulfil this NOS directly.
CSC/N1336	Coordinate with Co-workers for Work Efficiency	Industrial Engineering & Production Management	Production scheduling and workflow optimisation align with this NOS.
CSC/N0307	Prepare for Making Tools & Dies	Tool & Die Design; CNC Technology & CAM	Covers jig/fixture/press-tool design and CAM tool-path programming.
CSC/N0316	Perform Machining Operations	CNC Machining & CAM Programming Lab–I & II	Hands-on turning, milling and G-code programming — exact skill set.
CSC/N0308	Perform Fitting Operations	Manufacturing Workshop–I & II; IC Engines Workshop	Fitting skills reinforced through engine-maintenance assembly tasks.
CSC/N0309	Perform Assembly Operations	IC Engines & Machine Maintenance Workshop	Assembly of mechanical/engine components aligns directly to this NOS.
DGT/VSQ/N0102	Employability Skills	Professional Communication Skills	Quality-awareness and communication skills support employability.

YEAR 3 EXIT — NSQF Level 5.5 (Semesters V & VI)

Job Role: Low-Cost Automation Engineer (Production Engineering)
QP / NOS Code: ASC/N6464 — Fundamentals of Low-Cost Automation in Manufacturing Process
NSQC Reference: NSQC-approved 15/03/2024 (v1.0); NCO-2015 / 2144.0801
Occupation: Production Engineering
Sector / Council: Automotive (Automotive Skills Development Council — ASDC)
NOS Credits / Duration: 2 credits; 60 notional hours (15 h theory + 45 h practical)

NOS - Course Alignment

NOS / Element	Scope / Performance Outcome	Aligned Course (s)	Justification (Brief)
ASC/N6464 (PC1–PC4)	Conduct & evaluate the technology analysis of the existing manufacturing process	Industrial Training / OJT (Sem V); Project / Field Work	Shop-floor process study, identification of automatable areas, cost-saving potential and ROI assessment performed during industrial training.
ASC/N6464 (PC5–PC8)	Select & design the system & components of the low-cost	Industrial Training / OJT (Sem V); Computer	Designing low-cost automation elements within cost and safety constraints draws on

	automation system	Aided Design & CNC Technology / CAM (Sem II–IV)	CAD modelling and manufacturing-process knowledge.
ASC/N6464 (PC9–PC13)	Install & integrate the system with the existing manufacturing system	Industrial Training / OJT (Sem V & VI)	PLC/HMI control development and integration of robotic systems and conveyors are implemented directly on the shop floor with minimal disruption to production.
ASC/N6464 (PC14–PC18)	Test & optimise the low-cost automation system	Industrial Training / OJT (Sem VI); Project / Field Work	Testing for reliability and safety, cycle-time optimisation, documentation and regulatory compliance form the capstone OJT / Project deliverable.
ASC/N6464 (KU1–KU2, GS1–GS7)	Workplace health, safety, reporting & professional conduct	Industrial Training / OJT (Sem V & VI)	Occupational H&S, emergency procedures, team coordination, and report writing are embedded throughout the industrial training.

Rationale for the NSQF 5.5 Exit: Year 3 is dominated by 1,600+ contact hours of Industrial On-Job Training (OJT) across Semesters V and VI, supplemented by project and report work. This extended factory-floor experience qualitatively differentiates the graduate from the Level-5 exit: the student can independently plan, execute, supervise and quality-check low-cost operations — capabilities assessed at NSQF 5.5 under the production-supervisory framework. The OJT component also fulfils the SEC (Skill Enhancement Course) credit mandate and ensures industry readiness at the senior technician/junior engineer level.

Co-anchor NSQF 5.5 Roles

Role / QP	Strongest Scheme Link	Rationale
Additive Manufacturing - Design and Application Engineer - CSC/Q0412	Computer Aided Design Lab - I & II; Rapid Manufacturing (Elective)	CAD-to-print workflow and rapid/additive manufacturing skills.
Digital Twin Engineer - CSC/Q0411	Mechatronics; Computer Applications and Data Visualisation; Industry 4.0 (Elective)	Sensor-linked virtual modelling and data-driven process simulation.
Advanced Mechatronics Simulation Engineer - CSC/Q0423	Mechatronics; CNC Machining & CAM Programming Lab - I & II; Measurement & Instrumentation	CAD-based simulation + sensor/actuator integration.
Digital Factory Automation Engineer - CSC/Q0415	Industrial Robotics: Theories for Implementation (Elective); Industrial Training / OJT	Smart-factory automation exposure via electives and live-line OJT.

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
Community College of Skill Development (CCSD)
B.Voc. Mechanical Engineering (Manufacturing Engineering)
[NSQF Level 4.5, UG Regular]

TABLE 8
SCHEME FOR SEMESTER – I

Course Code	Course Title	Teaching Schedule				Teaching Hours			Marks for Sessional	Marks for End Term Examination		Total Marks	Credits	Course Type
		L	T	P	Total	L	P	O/A		Theory	Practical			
MRV-103-V1	Basics of Mechanical Engineering	4	0	0	4	60		60	40	60	-	100	4	DSC
AMV-103-V1	Engineering Materials and Manufacturing Processes	4	0	0	4	60		60	40	60	-	100	4	DSC
AMV-109-V1	Computer Aided Design Lab–I	-	-	4	4		60	60	25	-	25	50	2	DSC Lab
MRV-105-V1	Manufacturing Workshop–I (Fitting, Welding, Sheet-Metal basics)	-	-	6	6		90	90	25	-	25	50	3	DSC Lab
AMV-111-V1	Manufacturing and Materials Lab	-	-	2	2		30	30	25	-	25	50	1	DSC Lab
ESU-205-V1	Environmental Science	3	-	-	3	45		45	40	60	-	100	3	VAC
MRV-101-V1	Workshop Calculations and Analytical Techniques	3	-	-	3	45		45	40	60	-	100	3	MDC
Total		**14**	**0**	**12**	**26**	**210**	**180**	**390**	**235**	**240**	**75**	**550**	**20**	

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
Community College of Skill Development (CCSD)
B.Voc. Mechanical Engineering (Manufacturing Engineering)
[NSQF Level 4.5, UG Regular]

TABLE 9
SCHEME FOR SEMESTER – II

Course Code	Course Title	Teaching Schedule				Teaching Hours			Marks for Sessional	Marks for End Term Examination		Total Marks	Credits	Course Type
		L	T	P	Total	L	P	O/A		Theory	Practical			
MFV-102-V1	Engineering Thermodynamics & Heat Engines	4	0	0	4	60		60	40	60	-	100	4	DSC
MRV-104-V1	Engineering Mechanics & Strength of Materials	4	0	0	4	60		60	40	60	-	100	4	DSC
AMV-108-V1	Computer Aided Design Lab–II	-	-	4	4		60	60	25	-	25	50	2	DSC Lab
MRV-106-V1	Manufacturing Workshop–II	-	-	6	6		90	90	25	-	25	50	3	DSC Lab
VAC-201-V1	Indian Knowledge System	3		-	3	45		45	40	60		100	3	VAC
AEC-201-V1	Professional Communication Skills	4	-	-	4	60		60	40	60	-	100	4	AEC
Total		**15**	**0**	**10**	**25**	**225**	**150**	**375**	**210**	**240**	**50**	**500**	**20**	

Exit Option for U.G. Certificate (Level 4.5): Any student opting for exit after the second semester will receive a U.G. Certificate upon earning 40 credits from the first two semesters, plus an additional 4 credits, as per Table 7 (total 44 credits).

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
Community College of Skill Development (CCSD)
B.Voc. Mechanical Engineering (Manufacturing Engineering)
[NSQF Level 5, UG Regular]

TABLE 10
SCHEME FOR SEMESTER – III

Course Code	Course Title	Teaching Schedule				Teaching Hours			Marks for Session al	Marks for End Term Examination		Total Marks	Credits	Course Type
		L	T	P	Tot al	L	P	O/A		Theory	Practical			
	Fluid Mechanics & Fluid Machinery	4	0	0	4	60		60	40	60	-	100	4	DSC
	Industrial Engineering & Production Management	4	0	0	4	60		60	40	60	-	100	4	DSC
	Measurement & Instrumentation	3	-	-	3		45	45	40	60	-	100	3	DSC
	CNC Machining & CAM Programming Lab–I	-	-	8	8		120	120	25	-	25	50	4	DSC Lab
	Measurement & Instrumentation Lab	-	-	6	6		90	90	25	-	25	50	3	DSC Lab
	Business Management and Entrepreneurship Essentials	2	-	-	2	30		30	40	60	-	100	2	MDC
Total		**13**	**0**	**14**	**27**	**150**	**255**	**405**	**210**	**240**	**50**	**500**	**20**	

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
Community College of Skill Development (CCSD)
B.Voc. Mechanical Engineering (Manufacturing Engineering)
[NSQF Level 5, UG Regular]

TABLE 11
SCHEME FOR SEMESTER – IV

Course Code	Course Title	Teaching Schedule				Teaching Hours			Marks for Sessional	Marks for End Term Examination		Total Marks	Credits	Course Type
		L	T	P	Total	L	P	O/A		Theory	Practical			
	Tool & Die Design	4	0	0	4	60		60	40	60	-	100	4	DSC
	Mechatronics	4	0	0	4	60		60	40	60	-	100	4	DSC
	Computer Applications and Data Visualisation	3	-	-	3	45		45	40	60	-	100	3	MDC
	IC Engines & Machine Maintenance Workshop	-	-	4	4		60	60	25	-	25	50	2	DSC Lab
	CNC Machining & CAM Programming Lab–II	-	-	4	4		60	60	25	-	25	50	2	DSC Lab
	Theory of Machines	3	-	-	3	45		45	40	60	-	100	3	DSC
	Project	-	-	4	4		30	30	30	-	70	100	2	Project
Total		**14**	**0**	**12**	**26**	**210**	**150**	**360**	**240**	**240**	**120**	**600**	**20**	

Exit Option for U.G. Diploma (Level 5.0): Any student opting for exit after the fourth semester will get a UG Diploma on earning 40 + 40 credits of the first four semesters plus an additional 4 credits as per Table 7 (total 84 credits).

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
Community College of Skill Development (CCSD)
B.Voc. Mechanical Engineering (Manufacturing Engineering)
[NSQF Level 5.5, UG Regular]

TABLE 12
SCHEME FOR SEMESTER – V

Course Code	Course Title	Schedule	Credits	Marks for Sessional	Marks for End Term Examination	Total Marks
	Industrial Training / On-Job Training (OJT	600	17	150	350	500
	Program Elective - I	0	03	40	60	100
Total		**600**	**20**	**190**	**410**	**600**

List of Program Elective - I Courses

Course Code	Course Title
	Automation in Production Systems and Management
	Production and Operations Management
	Industry 4.0
	Industrial Robotics: Theories for Implementation
	Automation in Manufacturing

Note: During Semester Vth, the student undergoes full-time Industrial Training / OJT in industry, supplemented by a Training Report and a Seminar/Presentation.

Procedure for Evaluation of Industrial Training:
(A) End-Term (350 Marks): Training Report 100; Training Seminar 100; Training Viva 150.
(B) Continuous Assessment (150 Marks): Assessment by Internal Faculty 50; Assessment by Industrial Guide 100.

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
Community College of Skill Development (CCSD)
B.Voc. Mechanical Engineering (Manufacturing Engineering)
[NSQF Level 5.5, UG Regular]

TABLE 13
SCHEME FOR SEMESTER – VI

Course Code	Course Title	Schedule	Credits	Marks for Sessional	Marks for End Term Examination	Total Marks
	Industrial Training / On-Job Training (OJT)	600	17	150	350	500
	Program Elective -II	0	03	40	60	100
Total		**600**	**20**	**190**	**410**	**600**

List of Program Elective - II Courses

Course Code	Course Title
	Rapid Manufacturing
	Introduction to Internet of Things
	Advanced Machining Processes
	Robotics
	Mechatronics and Manufacturing Automation

During Semester VIth, the student undergoes full-time Industrial Training / OJT in industry, supplemented by a Training Report and a Seminar/Presentation. The full-year OJT in Vth and VIth semester consolidates NSQF 5.5 competency.

Procedure for Evaluation of Industrial Training:
(A) End-Term (350 Marks): Training Report 100; Training Seminar 100; Training Viva 150.
(B) Continuous Assessment (150 Marks): Assessment by Internal Faculty 50; Assessment by Industrial Guide 100.

DETAILED SYLLABI

BASICS OF MECHANICAL ENGINEERING
MRV-103-V1

No of Credits: 4 **Sessional: 40 Marks**
L T P Total Marks **Theory: 60**
4 0 0 4 Marks **Total: 100**

Course Objective:
To give first-year vocational students a simple, practical understanding of how mechanical systems work in a modern factory. The course uses everyday machine examples and avoids heavy mathematics. It introduces engineering materials, basic thermal and energy systems, power-transmission parts and routine maintenance and safety, so that the student becomes comfortable on the shop floor and ready for robotics and automation work that follows.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Explain the role of mechanical engineering in manufacturing and identify common engineering materials and their everyday properties and uses.
CO2: Describe the working of basic thermal and energy systems such as IC engines, boilers and pumps in simple language.
CO3: Identify common power-transmission and machine elements (gears, belts, chains, couplings, bearings) and state their function.
CO4: Describe basic manufacturing methods and follow routine maintenance, lubrication and safety practices at the workplace.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	2	1	2	1	–	–	2
CO2	3	2	2	2	1	–	–	2
CO3	3	2	2	2	1	–	–	2
CO4	3	2	1	3	1	1	1	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Manufacturing & Machining Skills)	PSO2 (Process Planning, Quality & Supervision)
CO1	2	1
CO2	2	1
CO3	3	1
CO4	2	2

Course Contents:

Unit 1: Introduction to Mechanical Engineering & Materials

Role of mechanical engineering in manufacturing, robotics and Industry 4.0; common machines and tools in a factory; SI units and simple shop-floor measurements. Engineering materials — metals (mild steel, cast iron, aluminium, copper), alloys, plastics and composites; basic mechanical properties (strength, hardness, ductility, toughness) in simple terms; how to select a material for a given job; introduction to ferrous and non-ferrous metals.

Unit 2: Basics of Thermal and Energy Systems

Forms of energy and common energy sources used in industry, heat, temperature and simple laws of thermodynamics in everyday language. Working principle of two-stroke and four-stroke IC engines; introduction to

boilers and steam; pumps and compressors used in workshops; refrigeration and air-conditioning basics; idea of efficiency and energy saving on the shop floor.

Unit 3: Power Transmission and Machine Elements

Why and how power is transmitted in machines; shafts, keys and couplings; belt, rope and chain drives; spur, helical, bevel and worm gears and simple gear trains; bearings (ball, roller, plain) and their selection; brakes and clutches in simple terms; relating these elements to robot joints, conveyors and CNC machines.

Unit 4: Manufacturing Basics, Maintenance and Safety

Overview of casting, forming, machining, welding and 3D printing as ways to make a part; introduction to lathe, drilling and milling machines; preventive vs breakdown maintenance; lubrication and cleanliness (5S); common shop-floor hazards and personal protective equipment (PPE); workplace safety signs and good housekeeping for a robotics/automation lab.

Textbooks & References:

1. Dharmendra Singh & Chandra Shekhar Rajoria, “Basic Mechanical Engineering”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-7530 — available in Hindi (हिंदी) and other regional languages.
2. Shubhankar Bhowmick, N. V. S. Naidu, “Basics of Mechanics”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-9381 — available in Hindi (हिंदी) and other regional languages.
3. M. P. Poonia, S. C. Sharma & T. R. Banga, “Basic Mechanical Engineering”, Khanna Publishing House, New Delhi.
4. G. Shanmugam & S. Ravindran, “Basic Mechanical Engineering”, McGraw Hill Education, 2021.

Suggested Tutorial / Sessional Assignments:

1. Prepare a labelled chart of five common engineering materials and write one real factory use of each.
2. Visit the workshop and list the machines you see; classify each as a thermal, transmission or manufacturing machine.
3. Draw a simple four-stroke engine cycle and explain each stroke in your own words (Hindi or English).
4. Compare belt drive vs gear drive with two advantages and two disadvantages each.
5. Identify the type of bearing used in a bicycle wheel, a ceiling fan and a CNC spindle.
6. Make a simple 5S checklist for a robotics lab and apply it for one week.
7. Prepare a one-page safety poster showing PPE for a welding/grinding area.
8. Survey a local workshop and note one example each of preventive and breakdown maintenance.
9. Calculate the gear ratio of a two-gear train given tooth numbers (simple numerical).
10. List the energy-saving steps you would suggest for a small manufacturing unit.

ENGINEERING MATERIALS AND MANUFACTURING PROCESSES
AMV-103-V1

No of Credits: 4 **Sessional: 40 Marks**
L T P Total **Theory: 60 Marks**
4 0 0 4 **Total: 100 Marks**

Course Objective:
To help vocational students understand the materials used in industry and the common ways parts are made, using simple language and shop-floor examples. The course builds the practical knowledge a robotics/automation technician needs to select materials, recognise manufacturing methods, and appreciate quality and safety, preparing them for CNC, welding, and assembly work in later semesters.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Identify common engineering materials, their properties and their suitable applications in manufacturing.
CO2: Explain basic metal-casting and metal-forming processes and where they are used in industry.
CO3: Describe machining, joining (welding) and sheet-metal processes in simple terms.
CO4: Explain basic heat treatment, modern manufacturing (3D printing) and quality/safety practices on the shop floor.

CO–PO Mapping:

Course Outcomes	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	2	1	2	1	–	–	2
CO2	3	2	2	2	1	–	–	2
CO3	3	2	3	2	1	–	–	2
CO4	3	2	2	3	1	1	–	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Manufacturing & Machining Skills)	PSO2 (Process Planning, Quality & Supervision)
CO1	2	1
CO2	2	1
CO3	3	2
CO4	2	2

Course Contents:

Unit 1: Engineering Materials and Their Properties

Classification of materials — metals, ceramics, polymers and composites; ferrous metals (mild steel, cast iron, alloy steels) and non-ferrous metals (aluminium, copper, brass); mechanical properties (strength, hardness, ductility, toughness, fatigue) explained simply; basic crystal structure idea; selecting the right material for automotive and robotic parts; introduction to smart and lightweight materials.

Unit 2: Casting and Metal Forming

Basics of foundry and sand casting; pattern, mould and core in simple terms; common casting defects; introduction to die casting. Metal forming — forging, rolling, extrusion, drawing and sheet-metal bending; hot working vs cold working; typical industrial products made by each process.

Unit 3: Machining and Joining Processes

Cutting tools and basics of metal removal; working of lathe, drilling, milling and grinding machines; introduction to CNC machining; sheet-metal operations (shearing, punching, bending). Joining processes — arc welding, gas welding, spot welding, soldering and brazing, riveting and adhesive bonding; safety in welding and machining.

Unit 4: Heat Treatment, Modern Manufacturing and Quality

Purpose of heat treatment — annealing, normalising, hardening and tempering in simple language; surface treatments and coatings for wear/corrosion protection. Introduction to additive manufacturing (3D printing) and its use in robotics; basics of inspection, tolerance and quality control; measuring instruments (vernier, micrometre); shop-floor safety and waste reduction.

Textbooks & References:

1. Dheerendra Kumar Dwivedi, “Materials Engineering”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-9886 — available in Hindi (हिंदी) and other regional languages.
2. Dheerendra Kumar Dwivedi, “Manufacturing Processes”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-7233 — available in Hindi (हिंदी) and other regional languages.
3. Veeranna D. K., “Workshop / Manufacturing Practices (with Lab Manual)”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-9150-5332 — available in Hindi (हिंदी).
4. P. N. Rao, “Manufacturing Technology, Vol. 1 & 2”, McGraw-Hill Education.

Suggested Tutorial / Sessional Assignments:

1. Collect five small metal samples and identify each as ferrous or non-ferrous with reasons.
2. Prepare a chart comparing casting, forging and machining for one common product.
3. Watch a welding demonstration and write the safety steps you observed.
4. Measure a given job using a vernier calliper and record the reading.
5. List three products around you made by sheet-metal work.
6. Draw a simple labelled sketch of a lathe and name its main parts.
7. Explain in your own words why hardening and tempering are done together.
8. Find one real example of a 3D-printed part used in robotics and describe it.
9. Prepare a defect list for a casting and suggest one remedy for each.
10. Make a material-selection table for three robot parts (gripper, base, cover).

COMPUTER AIDED DESIGN LAB–I
AMV-109-V1

No of Credits: 2 **Sessional: 25 Marks**
L T P Total Marks **Theory: 25**
0 0 0 4 Marks **Total: 50**

Course Objective:
To train vocational students in basic engineering drawing and 2D computer-aided design (CAD) using easy, step-by-step practice. Drawing is the language of industry; this lab builds the ability to read and make simple part drawings on AutoCAD-type software, which is essential before CNC, robotics and assembly work.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Use basic drawing instruments and CAD software interface to create simple 2D drawings.
CO2: Construct geometric shapes, dimensioning and orthographic (front/top/side) views of simple objects.
CO3: Read and interpret engineering drawings with scales, symbols and tolerances.
CO4: Prepare neat, dimensioned 2D part drawings useful for the manufacturing shop floor.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	2	3	1	1	–	–	2
CO2	3	3	3	1	1	–	–	2
CO3	3	2	3	2	2	–	–	2
CO4	3	2	3	2	1	–	–	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Manufacturing & Machining Skills)	PSO2 (Process Planning, Quality & Supervision)
CO1	3	1
CO2	3	1
CO3	2	2
CO4	3	2

Course Contents:

Unit 1: Drawing Basics and CAD Environment

Importance of engineering drawing in industry; drawing sheet, lines, lettering and dimensioning; introduction to CAD software (AutoCAD/equivalent), screen layout, coordinate system, units and basic commands (line, circle, arc, trim, offset).

Unit 2: Geometric Construction and Editing

Drawing polygons, tangents and simple curves; editing commands (copy, mirror, array, fillet, chamfer); layers, hatching and text; applying scale and dimensions correctly.

Unit 3: Orthographic and Sectional Views

Concept of first-angle projection; drawing front, top and side views of simple blocks and machine parts; sectional views and conventions; reading a given engineering drawing.

Unit 4: Component Drawings for the Shop Floor

Dimensioned 2D drawings of common parts (bracket, flange, plate, key, simple gripper part); title block and bill of materials; printing/plotting and saving in standard file formats.

Textbooks & References:

1. Pradeep Jain, “Engineering Graphics & Design”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-9150-5066 — available in Hindi (हिंदी) and other regional languages.
2. Sharad K. Pradhan & K. K. Jain, “Engineering Graphics”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-9150-5509 — available in Hindi (हिंदी).
3. N. D. Bhatt, “Engineering Drawing”, Charotar Publishing House.
4. Sham Tickoo, “AutoCAD: A Problem-Solving Approach”, CADCIM/Dreamtech.

List of Experiments:

1. Set up a drawing sheet with a border and title block in CAD.
2. Draw different types of lines and practise lettering and dimensioning.
3. Construct a regular hexagon and pentagon using CAD commands.
4. Draw the front, top and side views of a simple block.
5. Draw orthographic views of a stepped bracket with dimensions.
6. Create a sectional view of a hollow cylinder.
7. Draw a flange with a bolt-hole circle using the array command.
8. Prepare a dimensioned drawing of a simple robot base plate.
9. Read a given part drawing and prepare a bill of materials.
10. Plot/print a finished drawing to a PDF with the correct scale.

MANUFACTURING WORKSHOP–I
MRV-105-V1

No of Credits: 3 **Sessional: 25 Marks**
L T P Total **Theory: 25 Marks**
0 0 6 6 **Total: 50 Marks**

Course Objective:
To give students real, hands-on skills in fitting, welding, and sheet-metal work, with a strong emphasis on safety. These are core shop-floor abilities for any manufacturing or robotics technician and directly support the NSQF job roles of fitter, welder and machine assistant.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Follow workshop safety rules and use hand tools and measuring instruments correctly.
CO2: Perform basic fitting operations — marking, filing, drilling, tapping — to make a simple job to size.
CO3: Perform basic welding (arc/gas) joints safely and inspect them visually.
CO4: Make a simple sheet-metal article using marking, cutting, bending and joining.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	2	2	3	2	1	–	2
CO2	3	2	2	3	1	–	–	2
CO3	3	2	2	3	1	1	–	2
CO4	3	2	2	3	1	–	–	2

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Manufacturing & Machining Skills)	PSO2 (Process Planning, Quality & Supervision)
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1

Course Contents:

Unit 1: Workshop Safety, Tools and Measurement

Workshop safety rules, PPE and housekeeping (5S); common hand tools and bench equipment; measuring and marking tools (steel rule, vernier, try-square, scriber, punch); reading drawings for a job.

Unit 2: Fitting Practice

Marking and layout on metal; filing flat and square surfaces; sawing, drilling, reaming, tapping (internal threads) and dieing (external threads); making a simple mating/fitting job to given dimensions.

Unit 3: Welding Practice

Introduction to arc and gas welding; setting current/flame and safety; striking an arc and laying a bead; lap, butt and T-joints; common welding defects and visual inspection; soldering and brazing basics.

Unit 4: Sheet-Metal Practice

Sheet-metal tools and gauges; development/marking of a simple shape; shearing/cutting, bending, folding and forming; joining by riveting, seaming and spot welding; making a small tray/box article.

Textbooks & References:

1. Veeranna D. K., “Workshop / Manufacturing Practices (with Lab Manual)”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-9150-5332 — available in Hindi (हिंदी) and other regional languages.
2. A. K. Sarathe, “Engineering Workshop Practice”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-9150-5516 — available in Hindi (हिंदी).
3. Hajra Choudhary & Bose, “Elements of Workshop Technology, Vol. 1”, Media Promoters & Publishers.
4. H. S. Bawa, “Workshop Practice”, McGraw-Hill Education.

List of Experiments / Jobs:

1. Demonstrate correct use of PPE and identify five workshop safety signs.
2. Mark and file a mild-steel piece to a square 50×50 mm job.
3. Drill and tap an M8 hole in a given plate.
4. Make a simple male–female fitting job to ±0.5 mm.
5. Prepare a lap joint by arc welding and inspect it.
6. Prepare a butt joint by gas welding.
7. Solder two copper wires/strips neatly.
8. Develop and cut a sheet-metal pattern for a small tray.
9. Bend and form the tray and join the corners by riveting.
10. Record all jobs with sketches and dimensions in the workshop file.

MANUFACTURING AND MATERIALS LAB
AMV-111-V1

No of Credits: 1 **Sessional: 25 Marks**
L T P Total **Theory: 25 Marks**
0 0 2 2 **Total: 50 Marks**

Course Objective:
To let students see and test, with simple experiments, the materials and basic processes studied in theory. The lab builds practical familiarity with material testing and measurement that supports quality work in manufacturing and robotics.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Identify and test common engineering materials using simple laboratory methods.
CO2: Use basic measuring instruments to measure parts accurately.
CO3: Observe and record basic manufacturing process demonstrations.
CO4: Record observations and present simple results neatly in a lab report.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	2	2	2	1	–	–	2
CO2	3	2	3	2	1	–	–	2
CO3	3	2	2	2	1	–	–	2
CO4	3	2	2	2	2	–	–	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Manufacturing & Machining Skills)	PSO2 (Process Planning, Quality & Supervision)
CO1	2	2
CO2	2	2
CO3	2	1
CO4	1	3

Course Contents:

Unit 1: Material Identification and Testing

Identify ferrous/non-ferrous samples; simple hardness test (file/indentation idea), spark test demonstration; observe tensile/compression test on a universal testing machine (demo).

Unit 2: Measurement and Inspection

Use of vernier calliper, micrometre, and dial gauge; measuring length, diameter and thickness; tolerance and go/no-go gauge concept.

Unit 3: Manufacturing Process Demonstration

Demonstration of sand-casting mould preparation; observe a machining operation on a lathe/drilling machine; observe a welding joint; note process parameters.

Unit 4: Data Recording and Reporting

Record measurements in tables; calculate simple averages and errors; prepare a neat lab report with sketches and conclusions, linking results to material selection.

Textbooks & References:

1. Vinod Kumar & Nisheeth Kumar Prasad, “Material Science & Engineering”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-3877 — available in Hindi (हिंदी) and other regional languages.
2. Dheerendra Kumar Dwivedi, “Materials Engineering”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-9886 — available in Hindi (हिंदी).
3. Santosh Kumar, “Manufacturing Engineering”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-8148.
4. A. Gnanavelbabu et al., “Measurements and Metrology”, AICTE Prescribed Textbook (NEP 2020).

List of Experiments:

1. Identify five given material samples and tabulate their likely uses.
2. Measure three jobs using a vernier calliper and a micrometre: tabulate readings.
3. Perform a simple comparative hardness test on two metals.
4. Observe a tensile test demonstration and note the breaking behaviour.
5. Observe a sand-casting mould demonstration and sketch the mould.
6. Measure the thickness of sheets using a micrometre and check tolerance.
7. Observe a welding joint and record visual quality.
8. Prepare a lab report with averages and error for one measurement set.

ENVIRONMENTAL SCIENCE
ESU-205-V1

No of Credits: 3 **Sessional: 40 Marks**
L T P Total **Theory: 60 Marks**
3 0 0 3 **Total: 100 Marks**

Course Objectives:
The course aims to provide students with an understanding of the interactions between humans and the environment, natural resources, biodiversity, environmental pollution, climate change, and environmental management. It also seeks to develop awareness of sustainable development practices and familiarize students with national and international environmental laws and treaties for promoting responsible environmental stewardship.

Course Outcomes (COs): At the end of the course, the student shall be able to:

- **CO1:** Explain the historical evolution of human-environment interactions and the emergence of environmental thought and global environmentalism.
- **CO2:** Analyse the classification, utilisation, and sustainable management of natural resources, and relate them to the principles of sustainable development.
- **CO3:** Evaluate the concepts of biodiversity and ecosystem services, conservation approaches.
- **CO4:** Identify major types of environmental pollution and assess their sources, impacts on human health and ecosystems; assess the significance of climate change impacts, adaptation, and mitigation.
- **CO5:** Interpret key national and international environmental laws, treaties, and institutional mechanisms aimed at environmental protection and sustainable governance.

CO–PO Mapping

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality / Security)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	1	2	–	2	1	2	–	3
CO2	2	3	1	3	1	2	1	3
CO3	1	2	1	3	1	2	–	3
CO4	2	3	1	3	1	2	1	3
CO5	1	2	–	2	1	3	1	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping

Course Outcomes	PSO1 (Robotics / Automation Systems)	PSO2 (Data Acquisition & Analytics)
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1

Course Contents:

Unit – I: Humans and the Environment

The man-environment interaction: Humans as hunter-gatherers, Mastery of fire, Origin of agriculture, Great ancient civilisations and the environment, Industrial revolution and its impact on the environment, Population growth and natural resource exploitation. The emergence of environmentalism: Anthropocentric and eco-centric perspectives, The Club of Rome- Limits to Growth, UN Conference on Human Environment 1972, World Commission on Environment and Development, Rio Summit.

Unit – II: Natural Resources and Sustainable Development

Definition of resource; Classification of natural resources- biotic and abiotic, renewable and nonrenewable. Biotic resources: Major types of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (freshwater and marine), Microbes as a resource. Water resources: Types of water resources- fresh water and marine resources,

Availability and use, Environmental impact of over-exploitation, issues and challenges, Water scarcity and stress, Conflicts over water. Soil and mineral resources: Important minerals, Mineral exploitation, Environmental problems due to the extraction of minerals and their use, Soil as a resource and its degradation. Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy, Conventional energy sources- coal, oil, natural gas, nuclear energy, non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells, Implications of energy use on the environment. Introduction to sustainable development: Sustainable Development Goals (SDGs)

Unit – III: Environmental Issues: Local, Regional and Global

Temporal and spatial extents of local, regional, and global phenomena. Pollution: Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste, Transboundary air pollution, Acid rain, Smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanisation. Global issues: Ozone layer depletion, greenhouse effect, Global Warming, and climate change.

Unit – IV: Conservation of Biodiversity and Ecosystems

Ecosystems and ecosystem services: Concept, Structure and Functions of Ecosystem, Ecosystem types: forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services. Biodiversity and its distribution: Biodiversity as a natural resource, Levels and types of biodiversity, Biodiversity in India and the world, Biodiversity hotspots. Threats to biodiversity, in situ and ex-situ conservation approach, role of traditional knowledge, and community-based conservation.

Unit – V: Environmental Pollution and Health

Definition of pollution: Point sources and non-point sources of pollution. (5 hrs) Air pollution: Sources of air pollution, Primary and secondary pollutants, Criteria pollutants, Other important air pollutants- Volatile Organic compounds, Peroxyacetyl Nitrate, Polycyclic aromatic hydrocarbons and Persistent organic pollutants, Indoor air pollution, health impacts of air pollutants, National Ambient Air Quality Standards. Water pollution: Sources of water pollution, River, lake and marine pollution, groundwater pollution, Water quality parameters and standards, health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources, Solid and hazardous waste, Impact on human health. Noise pollution: Definition of noise, measurement and sources of noise pollution, Noise standards, impacts of noise on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.

Unit – VI: Climate Change: Impacts, Adaptation and Mitigation

Structure of atmosphere, Importance of 1.5 °C and 2.0 °C limits to global warming, Climate change projections for the Indian sub-continent. Impacts of climate change on ocean, land, forests and natural ecosystems, Impacts on animal species, agriculture, health, urban infrastructure; concept of vulnerability, Adaptation vs. resilience, Indigenous knowledge for adaptation to climate change. Mitigation measures: Greenhouse Gas (GHG) reduction vs. sink enhancement, carbon neutrality, Net-zero targets for the future, Energy efficiency measures, National climate action plan.

Unit – VII: Environmental Management

Introduction to environmental laws and regulations: Constitutional provisions- Article 48A, Article 51A (g); Introduction to environmental legislation on the forest, wildlife and pollution control. Environmental management system: ISO 14001. Environmental audit and impact assessment, Pollution control and management, Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability, Ecolabeling /Ecomark scheme.

Unit – VIII: Environmental Treaties and Legislation

Vienna Convention, Montreal Protocol, and the Kigali Amendment. Basel Convention, Stockholm Convention on Persistent Organic Pollutants, and Minamata Convention. United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Paris Agreement, and India's status as a party to major conventions.
National Green Tribunal, Convention on Biological Diversity (CBD), Cartagena Protocol, Nagoya Protocol, Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), Ramsar Convention on Wetlands of International Importance, Ramsar sites, United Nations Convention to Combat Desertification

(UNCCD).

Textbooks & Reference:

1. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
2. Berrang-Ford, L., J.D. Ford & J. Paterson (2011). Are we adapting to climate change? Global Environmental Change-Human and Policy Dimensions 21: 25-33.
3. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
4. De Anil, K. (2003). Environmental chemistry. New Age International.
5. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Publisher (Pearson)
6. India Code - Digital repository of all Central and State Acts: https://www.indiacode.nic.in/
7. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
8. Kaushik, A., & Kaushik, C. P. (2006). Perspectives in environmental studies. New Age International.
9. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
10. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
11. Ela Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
12. Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press

WORKSHOP CALCULATIONS AND ANALYTICAL TECHNIQUES
MRV-101-V1

No of Credits: 3 **Sessional: 40 Marks**
L T P Total **Theory: 60 Marks**
3 0 0 3 **Total: 100 Marks**

Course Objective:
To strengthen the everyday mathematics and measurement skills a shop-floor technician needs, taught in a simple, application-based way. The course covers practical arithmetic, mensuration, basic algebra and simple data handling so that students can read drawings, calculate quantities, estimate cost and make data-based decisions in manufacturing and analytics.

Course Outcomes (COs):
At the end of the course, the student shall be able to:

- **CO1**: Apply basic arithmetic, units, ratios, percentages, and unit conversion to workshop problems.
- **CO2**: Use mensuration and basic trigonometry to calculate length, area, volume and angles of parts.
- **CO3**: Apply simple algebra and graphs to solve practical shopfloor and measurement problems.
- **CO4**: Organise simple data and compute basic statistics (average, range) to support quality decisions.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	3	2	2	1	–	1	2
CO2	3	3	2	2	1	–	1	2
CO3	3	3	2	2	1	–	1	2
CO4	2	3	2	2	1	–	1	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Robotics / Automation Systems)	PSO2 (Data Acquisition & Analytics)
CO1	1	2
CO2	2	2
CO3	1	2
CO4	1	3

Course Contents:

Unit 1: Workshop Arithmetic, Units and Measurement

Number operations, fractions and decimals; ratio, proportion and percentage; SI and other units used in workshops; unit conversion; significant figures and rounding; reading scales and simple measurement errors; speed/feed and material-quantity calculations.

Unit 2: Mensuration and Basic Trigonometry

Perimeter, area and volume of common shapes (rectangle, triangle, circle, cylinder, cone); surface area and weight of material from volume and density; angles, right-angle triangle and basic trigonometric ratios; simple applications in marking, taper and pitch calculations.

Unit 3: Basic Algebra and Graphs

Algebraic expressions, simple linear equations and formulae transposition; using formulae for gear ratio, cutting speed, RPM and scaling; plotting and reading simple graphs (straight-line relationship); interpolation in tables.

Unit 4: Introduction to Data and Basic Statistics

Collecting and tabulating shop-floor data; bar charts, pie charts and line graphs; average (mean), median, mode and range; introduction to the idea of variation and simple quality checks; reading a process data sheet.

Textbooks & References:

1. Deepak Singh, “Mathematics-I”, AICTE Prescribed Textbook (Diploma, NEP 2020), ISBN 978-93-9150-5424 — available in Hindi (हिंदी) and other regional languages.
2. “कार्यशाला गणना एवं विज्ञान / Workshop Calculation & Science”, Khanna Book Publishing — Hindi (हिंदी) medium edition.
3. Garima Singh, “Mathematics-II”, AICTE Prescribed Textbook (Diploma, NEP 2020), ISBN 978-93-9150-5523 — available in Hindi (हिंदी).
4. B. V. Ramana, “Higher Engineering Mathematics” (selected basic topics), McGraw-Hill.

Suggested Tutorial / Sessional Assignments:

1. Convert a set of given measurements between mm, cm, m and inches.
2. Calculate the weight of a steel bar from its volume and density.
3. Find the area of a given sheet-metal development.
4. Calculate the RPM for a given cutting speed and diameter.
5. Work out the gear ratio for a given pair of gears.
6. Plot a straight-line graph from a given set of readings and read an in-between value.
7. Tabulate ten sample readings and find mean, median, mode and range.
8. Prepare a bar chart and a pie chart from the given production data.
9. Calculate taper and pitch for a given job.
10. Estimate material quantity and cost for a simple batch of parts.

ENGINEERING THERMODYNAMICS & HEAT ENGINES
MFV-102-V1

No of Credits: 4 **Sessional: 40 Marks**
L T P Total Marks **Theory: 60**
4 0 0 4 Marks **Total: 100**

Course Objective:
To give vocational students a simple, practical understanding of how heat and energy are converted into useful work in machines, using everyday examples and easy numericals. The course covers the basic laws of thermodynamics, steam and boilers, and the working of heat engines such as petrol and diesel engines. It builds the energy and engine knowledge a mechanical/manufacturing technician needs for power plants, automobiles, maintenance and energy-saving work on the shop floor.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Explain basic thermodynamic concepts and apply the first law of thermodynamics to simple non-flow and steady-flow processes.
CO2: Apply the second law, explain entropy and evaluate the performance of heat engines, refrigerators and heat pumps.
CO3: Describe the formation and properties of steam and the construction and working of boilers with their mountings and accessories.
CO4: Explain air-standard cycles and the working and basic performance of IC engines and other heat engines used in industry.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	3	1	1	1	–	–	2
CO2	3	3	2	2	1	–	–	2
CO3	3	2	2	2	1	–	–	2
CO4	3	3	2	2	1	–	1	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Manufacturing & Machining Skills)	PSO2 (Process Planning, Quality & Supervision)
CO1	1	1
CO2	1	2
CO3	2	2
CO4	2	2

Course Contents:

Unit 1: Basic Concepts and the First Law of Thermodynamics

Thermodynamic system, surroundings and boundary; open, closed and isolated systems; properties, state, path, process and cycle; equilibrium and the quasi-static process; temperature and the Zeroth Law; heat and work as forms of energy and their sign convention; the First Law of Thermodynamics; internal energy and enthalpy; application of the first law to non-flow processes (constant volume, constant pressure, isothermal, adiabatic) and to the steady-flow energy equation (boiler, turbine, pump, nozzle) — simple problems.

Unit 2: Second Law of Thermodynamics and Entropy

Limitations of the first law: thermal reservoir, heat engine, refrigerator and heat pump; thermal efficiency and coefficient of performance (COP); statements of the Second Law (Kelvin–Planck and Clausius); reversible and irreversible processes; the Carnot cycle and Carnot efficiency; concept of entropy and its increase principle in simple terms; simple numerical problems on efficiency and COP.

Unit 3: Properties of Steam and Boilers

Formation of steam at constant pressure; wet, dry-saturated and superheated steam; dryness fraction; enthalpy and specific volume of steam; introduction to and use of steam tables; classification of boilers (fire-tube and water-tube), examples (Cochran, Babcock & Wilcox) in simple terms; boiler mountings and accessories and their functions; boiler safety; idea of boiler efficiency.

Unit 4: Heat Engines, IC Engines and Power Cycles

Air-standard cycles — Otto and Diesel cycles in simple terms and their efficiency; classification of IC engines; construction and working of two-stroke and four-stroke petrol and diesel engines; main engine components and the valve-timing idea; simple performance terms (IP, BP, mechanical efficiency, SFC); introduction to gas turbines and to refrigeration and air-conditioning; energy conservation in heat engines.

Textbooks & References:

1. Parmod Kumar & Atul Dhar, “Basics of Thermodynamics”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-6250 — available in Hindi (हिंदी) and other regional languages.
2. M. Rizwan & Majid Jamil, “Energy Science and Engineering”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-5147 — available in Hindi (हिंदी).
3. “अभियांत्रिकी ऊष्मागतिकी एवं ऊष्मा इंजन / Engineering Thermodynamics and Heat Engines”, Khanna Book Publishing — Hindi (हिंदी) medium edition.
4. P. K. Nag, “Engineering Thermodynamics”, McGraw-Hill Education.
5. R. K. Rajput, “Thermal Engineering”, Laxmi Publications.

Suggested Tutorial / Sessional Assignments:

1. Classify five given examples into open, closed and isolated systems with reasons.
2. Solve a simple first-law problem for a constant-pressure (or constant-volume) process.
3. Apply the steady-flow energy equation to a boiler or turbine (simple numerical).
4. Compare a heat engine, a refrigerator and a heat pump in a labelled chart.
5. Calculate the efficiency of a Carnot engine working between two given temperatures.
6. Find the COP of a refrigerator for given heat and work values.
7. Use steam tables to find the enthalpy of wet and superheated steam for given data.
8. Prepare a labelled sketch of a boiler and list its main mountings and accessories.
9. Draw the four strokes of a four-stroke petrol engine and explain each.
10. Compare petrol and diesel engines on five points and list one energy-saving measure.

ENGINEERING MECHANICS & STRENGTH OF MATERIALS
MRV-104-V1

No of Credits: 4 **Sessional: 40 Marks**
L T P Total **Theory: 60 Marks**
4 0 0 4 **Total: 100 Marks**

Course Objective:
To build a simple, practical understanding of forces, motion and the strength of materials used in machines and structures. The course uses simple numerical examples and real-world examples (beams, shafts, joints, robot links) so that students can assess how parts carry loads and avoid failure — essential for design, maintenance, and safety in manufacturing and robotics.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Apply the basic principles of forces and equilibrium to solve simple statics problems.
CO2: Analyse simple machines, friction and motion (kinematics) in everyday systems.
CO3: Explain stress, strain and the behaviour of materials under load.
CO4: Calculate basic stresses in members, beams and shafts to judge safe working of parts.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	3	2	2	1	–	–	2
CO2	3	3	2	2	1	–	–	2
CO3	3	3	2	3	1	–	–	2
CO4	3	3	3	3	1	–	–	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Manufacturing & Machining Skills)	PSO2 (Process Planning, Quality & Supervision)
CO1	3	1
CO2	3	1
CO3	2	2
CO4	3	2

Course Contents:

Unit 1: Statics — Forces and Equilibrium

Force, system of forces, resultant and components; free-body diagram; conditions of equilibrium; moment of a force and couple; support reactions of simple beams; equilibrium of a body under coplanar forces (simple problems).

Unit 2: Friction, Simple Machines and Motion

Laws of friction and applications; ladder/inclined-plane problems (simple); simple machines — levers, pulleys, screw jack and mechanical advantage; basics of motion (kinematics) — distance, velocity, acceleration; introduction to dynamics in simple terms; centre of gravity and centroid idea.

Unit 3: Simple Stress and Strain

Concept of stress and strain; tensile, compressive and shear stress; Hooke's law and modulus of elasticity; stress–strain curve for mild steel; factor of safety and working stress; thermal stress; behaviour of ductile and brittle materials.

Unit 4: Bending, Shafts and Practical Strength

Types of beams and loads; idea of shear force and bending moment (simple cases); bending stress in beams (concept and simple use of formula); torsion of shafts and power transmitted (basic); selecting a safe size for a member; relating to robot links, frames and fasteners.

Textbooks & References:

1. Bhankhar Bharat Gokaldas & Vandana Somkuwar, “Engineering Mechanics (with Lab Manual)”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-9150-5608 — available in Hindi (हिंदी) and other regional languages.
2. Uday Shanker Dixit, Nelson Muthu & S. M. Kamal, “Strength of Materials”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-5956 — available in Hindi (हिंदी).
3. R. S. Khurmi, “Engineering Mechanics”, S. Chand Publishing.
4. R. K. Bansal, “Strength of Materials”, Laxmi Publications.

Suggested Tutorial / Sessional Assignments:

1. Draw a free-body diagram for a given loaded beam and find the reactions.
2. Find the resultant of three coplanar forces (numerical).
3. Solve a simple ladder-friction problem.
4. Calculate the mechanical advantage of a screw jack.
5. Compute stress and strain for a bar under a given load.
6. Sketch the stress–strain curve of mild steel and mark key points.
7. Find a safe diameter of a rod for a given load and factor of safety.
8. Compute the thermal stress in a fixed bar for a given temperature rise.
9. Calculate the bending moment at the centre of a simply supported beam.
10. Estimate the power transmitted by a shaft for a given torque and speed.

COMPUTER AIDED DESIGN LAB–II
AMV-108-V1

No of Credits: 2 **Sessional: 25 Marks**
L T P Total **Theory: 25 Marks**
0 0 4 4 **Total: 50 Marks**

Course Objective:
To advance students from 2D drawing to 3D part modelling and simple assembly using parametric CAD software. These skills are directly used in product design, 3D printing and robotics, and prepare students for CNC/CAM work in the second year.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Create 3D part models from 2D sketches using a parametric CAD package.
CO2: Apply features such as extrude, revolve, fillet, pattern and shell to build components.
CO3: Assemble parts with mating constraints and check basic fit.
CO4: Generate dimensioned 2D production drawings from 3D models for the shop floor.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	3	3	2	1	–	–	2
CO2	3	3	3	2	1	–	–	2
CO3	3	3	3	2	2	–	–	2
CO4	3	2	3	2	1	–	–	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Manufacturing & Machining Skills)	PSO2 (Process Planning, Quality & Supervision)
CO1	3	1
CO2	3	1
CO3	3	2
CO4	3	2

Course Contents:

Unit 1: Sketching and Part Modelling

Introduction to 3D CAD (Fusion/SolidWorks/FreeCAD type); constrained sketching; extrude and revolve to make simple solids; the parametric/feature-tree idea.

Unit 2: Advanced Features

Fillet, chamfer, shell, rib, hole and pattern features; reference planes; editing dimensions to change the model; modelling common machine parts.

Unit 3: Assembly Modelling

Inserting parts, applying mates/constraints; building a small assembly (e.g., simple gripper or bracket-bolt assembly); interference/fit check; exploded view.

Unit 4: Drawing Generation and Output

Creating drawing views from a 3D model; dimensioning, section and detail views; title block and BOM; exporting STL for 3D printing and PDF for the shop floor.

Textbooks & References:

1. Pradeep Jain, “Engineering Graphics & Design”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-9150-5066 — available in Hindi (हिंदी) and other regional languages.
2. Kanak Kalita, “Computer Aided Machine Drawing Practice”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-5538-3570 — available in Hindi (हिंदी).
3. N. D. Bhatt & V. M. Panchal, “Machine Drawing”, Charotar Publishing House.
4. Sham Tickoo, “SolidWorks / Fusion 360 for Designers”, CADCIM/Dreamtech.

List of Experiments:

1. Model a simple block with a through hole using extrude.
2. Create a stepped shaft using Revolve.
3. Apply fillet, chamfer and shell to a box model.
4. Use a circular pattern to make a bolt-hole flange.
5. Model a simple bracket from a given 2D drawing.
6. Build a two-part assembly with mates and check the fit.
7. Create an exploded view of the assembly.
8. Generate a dimensioned drawing from a 3D model.
9. Export a part as STL for 3D printing.
10. Model a simple robot gripper finger and prepare its drawing.

MANUFACTURING WORKSHOP–II
MRV-106-V1

No of Credits: 3 **Sessional: 25 Marks**
L T P Total Marks **Theory: 25**
0 0 6 6 Marks **Total: 50**

Course Objective:
To develop higher-level manufacturing skills in machining, advanced welding and basic machine maintenance/assembly. Building on Workshop-I, this lab makes the student confident with lathes, drilling and milling machines, and in producing and assembling real parts, supporting roles in CNC and automation.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Operate lathe, drilling and milling machines safely to produce simple components.
CO2: Perform advanced welding/joining jobs and inspect their quality.
CO3: Carry out basic assembly, fitting and alignment of machine parts.
CO4: Apply measurement, maintenance and safety practices in a production setting.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	2	3	3	2	1	–	2
CO2	3	2	2	3	1	1	–	2
CO3	3	2	2	3	2	–	–	2
CO4	3	2	3	3	2	1	–	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Manufacturing & Machining Skills)	PSO2 (Process Planning, Quality & Supervision)
CO1	3	1
CO2	2	1
CO3	2	1
CO4	2	2

Course Contents:

Unit 1: Machining Practice

Lathe operations — facing, turning, step turning, taper turning, knurling and threading; drilling and reaming; introduction to milling (slot/face); selecting speed and feed; tool and job holding with safety.

Unit 2: Advanced Welding and Joining

Multi-pass arc welding; different positions; introduction to MIG/TIG (demo); welding of sheet and pipe; weld inspection and common defects; basic gas cutting.

Unit 3: Assembly, Fitting and Alignment

Reading an assembly drawing; fitting mating parts; use of fasteners and tightening sequence; simple alignment and levelling; press-fit and key/keyway assembly.

Unit 4: Measurement, Maintenance and Safety

Precision measurement (vernier, micrometre, bore gauge); quality check against tolerance; routine machine maintenance and lubrication; housekeeping (5S) and full workshop safety; recording job sheets.

Textbooks & References:

1. Veeranna D. K., “Workshop / Manufacturing Practices (with Lab Manual)”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-9150-5332 — available in Hindi (हिंदी) and other regional languages.
2. A. K. Sarathe, “Engineering Workshop Practice”, AICTE Prescribed Textbook (NEP 2020), ISBN 978-93-9150-5516 — available in Hindi (हिंदी).
3. Hajra Choudhary & Bose, “Elements of Workshop Technology, Vol. 1 & 2”, Media Promoters & Publishers.
4. P. N. Rao, “Manufacturing Technology, Vol. 1”, McGraw-Hill Education.

List of Experiments / Jobs:

1. Perform facing and plain turning on a mild-steel rod to the given size.
2. Make a step-turning job with two diameters.
3. Cut an external thread on the lathe.
4. Drill and ream a hole to a precise size.
5. Make a simple milling slot on a given block.
6. Prepare a multi-pass butt weld and inspect it.
7. Demonstrate gas cutting of a plate.
8. Assemble a bolted joint with the correct tightening sequence.
9. Measure a finished job and check it against tolerance.
10. Carry out routine lubrication and 5S on a machine and record it.

INDIAN KNOWLEDGE SYSTEM
VAC-201-V1

No of Credits: 3
L T P Total
3 0 0 3

Sessional: 40 Marks
Theory: 60 Marks
Total: 100 Marks

Course Objective:
The course aims to provide an understanding of the foundations of Indian Knowledge Systems, highlight India's contributions in diverse fields of knowledge, familiarise students with traditional approaches to holistic development and ethical living, and emphasise the relevance of Indian knowledge traditions in contemporary education, professions, and society.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
- CO1: Explain the origin, scope, and foundational principles of Indian Knowledge Systems.
- CO2: Describe the contributions of ancient India in science, mathematics, astronomy, and linguistics traditions.
- CO3: Examine Indian approaches to health, architecture, environment, and sustainable living practices.
- CO4: Apply principles of Indian ethics, governance, and management traditions in personal and professional life.

CO-PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality / Security)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	1	2	–	1	1	2	–	3
CO2	1	2	–	1	1	1	–	3
CO3	1	2	–	2	1	2	1	3
CO4	1	2	–	2	2	3	2	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes	PSO1 (Robotics / Automation Systems)	PSO2 (Data Acquisition & Analytics)
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1

Course Contents:

Unit 1: Foundations of Indian Knowledge Systems

Concept, meaning and significance of Indian Knowledge Systems; sources of Indian knowledge, including Vedas, Upanishads, Puranas and Epics; overview of major philosophical systems (Darshanas); fundamental principles and relevance of IKS in modern education and society.

Unit 2: Indian Knowledge Traditions in Science, Mathematics and Linguistics

Scientific traditions in ancient India; contributions of Aryabhata, Brahmagupta and Baudhayana; arithmetic, geometry, trigonometry and Vedic mathematics; Indian astronomy; Panini's contribution to linguistics; introduction to Vakyashastra and Pramanashastra.

Unit 3: Indian Traditions in Health, Wellness, Architecture and Sustainable Living

Indian perspective of psychology and holistic development; Ashtanga Yoga and Rasa Siddhanta; introduction to Ayurveda and preventive healthcare; principles of Vastushastra and traditional architecture; ancient Indian city planning and sustainable living practices.

Unit 4: Indian Knowledge Systems in Governance and Management

Indian economic thought in the Arthashastra and the Nitishastra; leadership, motivation, and financial management in Indian traditions; ethics and value-based governance; indigenous entrepreneurship and community economy.

Textbooks & References:

1. Mahadevan, B., Bhat, V. R., & Pavana, R. N. (2022). Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning Pvt. Ltd., New Delhi.
2. Radhakrishnan, S. (2009), Indian Philosophy (Vol. I & II). Oxford University Press, New Delhi.
3. Kapoor, Kapil & Singh, Avadhesh Kumar (Eds.), (2019). Indian Knowledge Systems: Knowledge Traditions and Practices of India, Indian Institute of Advanced Study, Shimla.
4. Kangle, R. P. (Ed. & Trans.). (2010 Reprint), The Kautiliya Arthashastra (Parts I–III), Motilal Banarsidass Publishers Pvt. Ltd., Delhi.
5. Daegens, Bruno. (2007), Mayamatam: Indian Treatise on Housing, Architecture and Iconography, Indira Gandhi National Centre for the Arts, New Delhi.
6. Dave, N. V. (2002), Vedanta and Management: Relevance of Vedantic Concepts in Modern Management Practices, Deep & Deep Publications Pvt. Ltd., New Delhi.
7. Rao, S. Balachandra. (2000), Indian Astronomy: An Introduction, Universities Press (India) Pvt. Ltd., Hyderabad.
8. Ramasubramanian, K., Sriram, M. S., & Srinivas, M. D. (2011), Tantrasangraha with Detailed Mathematical Explanatory Notes. Hindustan Book Agency, New Delhi.
9. Bhate, Saroja. (2002), Panini's Grammar: An Overview. Sahitya Akademi, New Delhi.
10. Ramachandrudu, P. (2010), Glimpses into Kautilya's Arthashastra, Sanskrit Academy, Hyderabad.
11. Tirthaji Maharaj, Jagadguru Swami Sri Bharati Krishna. (1965), Vedic Mathematics, Motilal Banarsidass Publishers Pvt. Ltd., Delhi.

PROFESSIONAL COMMUNICATION SKILLS
AEC-201-V1

No of Credits: 4 **Sessional: 40 Marks**
L T P Total Marks **Theory: 60**
0 0 4 4 Marks **Total: 100**

Course Objective:
To develop students' foundational proficiency in English language usage by strengthening grammar, vocabulary, sentence construction and basic writing skills. The course aims to improve learners' ability to read, understand and compose clear English for academic, workplace and everyday communication.

Course Outcomes (COs):
At the end of the course, the student shall be able to:
CO1: Identify and correctly use parts of speech, tenses, voice, and narration in written and spoken English.
CO2: Communicate effectively with stakeholders (customers, colleagues, industry partners) using appropriate professional etiquette.
CO3: Draft professional documents, including letters, reports, emails, resumes, and essays.
CO4: Demonstrate effective presentation, group discussion, and interview skills with appropriate body language and confidence.
CO5: Apply soft skills such as teamwork, leadership, paraphrasing, and feedback-giving in workplace scenarios.

CO–PO Mapping:

Course Outcomes (COs)	PO1 (Voc/Tech)	PO2 (Prob. Solving)	PO3 (Tool Usage)	PO4 (Quality/Safety)	PO5 (Comm/Team)	PO6 (Ethics)	PO7 (Entre/Mgmt)	PO8 (Lifelong)
CO1	3	2	3	1	1	1	2	2
CO2	3	2	3	1	1	1	2	2
CO3	2	2	3	2	1	1	2	2
CO4	2	2	3	2	2	1	3	3

Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.

CO–PSO Mapping:

Course Outcomes (COs)	PSO1 (Robotics / Automation Systems)	PSO2 (Data Acquisition & Analytics)
CO1	3	2
CO2	3	2
CO3	2	3
CO4	2	3

Course Contents:

Unit 1: GRAMMAR FOUNDATIONS

Parts of Speech: Noun, Pronoun, Verb, Adverb, Adjective, Preposition, Conjunction, Interjection, Tenses: Present, Past, Future (identification and sentence construction), Sentence Formation: Simple, Compound, Complex, Compound-Complex, Active-Passive Voice, Direct-Indirect Narration, Word Formation: Prefix, Suffix, Roots, Antonyms, Synonyms, Phrases & Idioms.

Unit 2: WRITING SKILLS

Letter Writing: Formal, Application, Covering, Business Letters, Report Writing: Academic, Business, Technical, News Reports, Essay Writing, Articles, Story Narration, E-mail Writing and Resume Writing, Reading Comprehension (skimming, scanning, summarising).

Unit 3: VERBAL & NON-VERBAL COMMUNICATION

Communication: Meaning, Importance, Functions, Types, Barriers & Solutions, Telephonic Communication Skills: Opening/closing calls, dealing with angry customers, Listening & Speaking Skills: Literacy skills integration, Body Language: Gesture, Posture, Facial Expression, Paraphrasing & Basic Translation skills, Reading Skills: Levels of reading, skimming, scanning.

Unit 4: EMPLOYABILITY & PERSONALITY DEVELOPMENT

Soft Skills: Definition, Importance, Process, Measurement, Teamwork Skills, Leadership Skills, Interview – Types (Mock interviews), Personality Development: Types, Programs & Techniques, Group Discussion – strategies and practice, Presentation Skills: Types, making effective presentations, Feedback: Giving and receiving constructive feedback, Stakeholder Communication: Customers, industry partners, suppliers, agents.

Textbooks & References:

1. Wren and Martin, High School English Grammar and Composition, latest edition, S. Chand.
2. Raymond Murphy, Essential English Grammar, latest edition, Cambridge University Press.
3. Prerna Malhotra & Deb Halder, Communication Skills: Theory and Practice.
4. B. Mishra & S. Sharma, Communication Skills for Engineers and Scientists.
5. Selected reading passages, worksheets and teacher-prepared handouts for grammar, vocabulary and writing practice.

Suggested Tutorial / Sessional Assignments:

1. Identify and classify the parts of speech in a short paragraph and explain the function of each highlighted word.
2. Rewrite a set of sentences in present, past and future tense without changing their meaning.
3. Form new words using prefixes and suffixes, and use them correctly in original sentences.
4. Replace underlined words in a passage with suitable synonyms or antonyms based on context.
5. Convert sentences from active to passive voice and from direct to indirect narration.
6. Combine short clauses into simple, compound and complex sentences.
7. Write a short paragraph on a familiar topic using correct tense forms and connectors.
8. Write an essay or article on a given topic with a clear introduction, body and conclusion.
9. Read a comprehension passage and answer factual, vocabulary-based and inferential questions.
10. Develop a short story using suitable conjunctions, interjections and descriptive vocabulary.

Practical Exercises

1. Grammar & Writing – Identify parts of speech in a paragraph; convert sentences across tenses, voice, narration; write a story using prepositions, conjunctions, interjections.
2. Letter & Report Writing – Draft formal letters, resumes, and reports from case studies.
3. Group Discussion & Paraphrasing – Participate in GD; paraphrase given passages.
4. Role-plays – Team projects, leadership situations, telephonic role-plays (customer service scenarios).
5. Presentations – Deliver short presentations focusing on non-verbal cues (gesture, posture).