Bachelor of Technical Education (B Tech Ed)

(Mechanical Engineering- General)

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Bachelor of Technical Education (B. Tech. Ed.) Program: Program Context

Technical and Vocational Education and Training (TVET) has been one of the prominent sectors globally for a long. Dewey (1916) saw TVET as a tool for education reform in modernizing society. This has been equally vibrant in the present context as scholars (e.g. Maclean & Wilson, 2009) argue that TVET is an education and training that prepares an individual for gainful employment. TVET programs equip young people with the skills, knowledge, and competencies required to enter a particular type of professional career (OECD 2017). Hence, the role of TVET in preparing skilled human resources and enabling them to transition into the career path for gainful employment in specific and the country's economic development in a broad is inevitable.

Background

The formal TVET began in Nepal only around mid of the 20th century. Nevertheless, occupational skills have been transformed from generation to generation for a long (Ministry of Education [MoE], 2012). The establishment of the Council for Technical Education and Vocational Training (CTEVT), the governing body of TVET in 1989, was a substantive effort toward its development and expansion (CTEVT, 2019). Additionally, at present, the Centre for Education and Human Resource Development (CEHRD) offering technical diplomas in 284 technical stream schools throughout the country (GoN, 2018) and universities (such as Kathmandu University, Manmohan Technical University, etc.) run bachelor and master in TVET and other 11 federal ministries offer TVET related formal and non-formal programs (MoEST, 2019).

The CTEVT, which is in charge of formulating TVET-relevant policies, developing standards for programs and curriculums, coordination, accreditation, monitoring, and supervision (CTEVT, 2019) largely shares the TVET related activities. There are 1131 CTEVT affiliated and constituent institutions with roughly the average capacity of 70,000 per annual operate formal TVET programs (CTEVT, 2020). Further expansion of TVET institutions in the country is yet to be expected soon since the government has a provision of establishing at least one technical school in all local levels.

The Gap

The existing human resource related to TVET is insufficient. For example, there are 932 permanent employees in CTEVT to manage, implement, and regulate 31 programs in about 1500 constituent and affiliated Polytechnics (technical schools), community schools, and private institutions across the country (CTEVT, 2019). Of course, this figure of institutions will surge shortly with

mushrooming TVET schools as the establishment has begun from provincial and local governments, especially after the federal restructure. The CTEVT constituent Polytechnics have only a few permanent instructors, while most other required are hired on a temporary and contract basis. Community schools running CEHRD technical programs are provisioned for 2 to 4 teachers; however, a permanent teacher has not been recruited. This shows most of the instructors in the technical schools are hired as per the needs and such instructors are very less or without pedagogical knowledge on the respective subject as the instructors are from a technical background such as engineering, agriculture, technology, etc that do not necessarily cover the pedagogical aspect. This scarcity of teachers in technical schools of Nepal is also anticipated in School Sector Development Programme (SSDP) (2016), which aimed at preparing 998 specialized teachers by 2021 in the technical subjects. Insufficient of specialized teachers in technical schools yet to be seen in the days to come with the government's current policy of establishment of at least one TVET school at all local levels and increasing share of students' enrolment from about 15% of the present situation to 70% of total student in secondary level education (MOEST, 2019).

The education policy (2019) envisions access to TVET education for all. However, this is only possible when competent and specialized teachers are available for different technical programs in Nepal. The existing human resource shows technical schools have a severe lack of specialized teachers. There needs immediate action for preparing competent teachers to enhance the quality of technical education in all governments.

Bachelor of Technical Education (B Tech Ed) of Kathmandu University is the only program that prepares teachers in technical and vocational education and training in Nepal. B Tech Ed is a pioneer bachelor program and implemented by Technical Institute for Technical Instructors (TITI). The program aims at preparing instructors, teachers, or trainers in technical subjects (TITI, 2021). The expansion of the B Tech Ed program will be a milestone if it fulfils teachers' demands in technical schools, which has been a profound lack with a constant increase in the TVET institutions/programs.

The TVET programs are primarily in the secondary level education, and an instructor is required to have a minimum bachelor degree educational qualification. BTech, one of the innovative programs started realizing the need for technical human resources in Nepal to meet such requirements. The Program equips a student with a different technical background with classroom instruction or pedagogical aspects in their specialized subjects. The Program is run by TITI with the expectation that it would fulfill the need of the technical schools across the country. However, at the existing pace, fulfilling the requirement would be almost impossible since every year roughly 10 students are graduated from the Program. Nonetheless, this program would be supportive to the local government and provincial governments if the program is expanded and more students are graduated. In this regard, its immediate expansion is necessary for the decentralized context. For this, the collaboration with relevant stakeholders, in all level of governments need to be established

so that it will on the one hand support preparing good instructors, on the other hand, sustain the TVET programs with the engagement of quality teachers.

In the federal context, it would be rational to run the Program in a decentralized manner**.** Running a TVET program is costly, in this sense, it might be difficult to generate resources for huge investments across the country. In this respect, the university can collaborate with the relevant stakeholders such as polytechnic, private sectors, etc. preparing the teachers which may have already well-functioning labs and infrastructure in all provinces or even in the local governments. It would be also an opportunity for the university to fulfil the demand that it can develop its lab according to trade-specific occupation and that would be a contribution to preparing competent teachers/instructors in a decentralized context.

The Bachelor of Technical Education (B. Tech. Ed.) Program

The purpose of the Bachelor of Technical Education (B. Tech. Ed.) is to prepare individuals for careers in the private and public sector at the level of instructor, teacher, trainer, or professionals in technical and vocational education subject areas.

The following are the aims of the program:

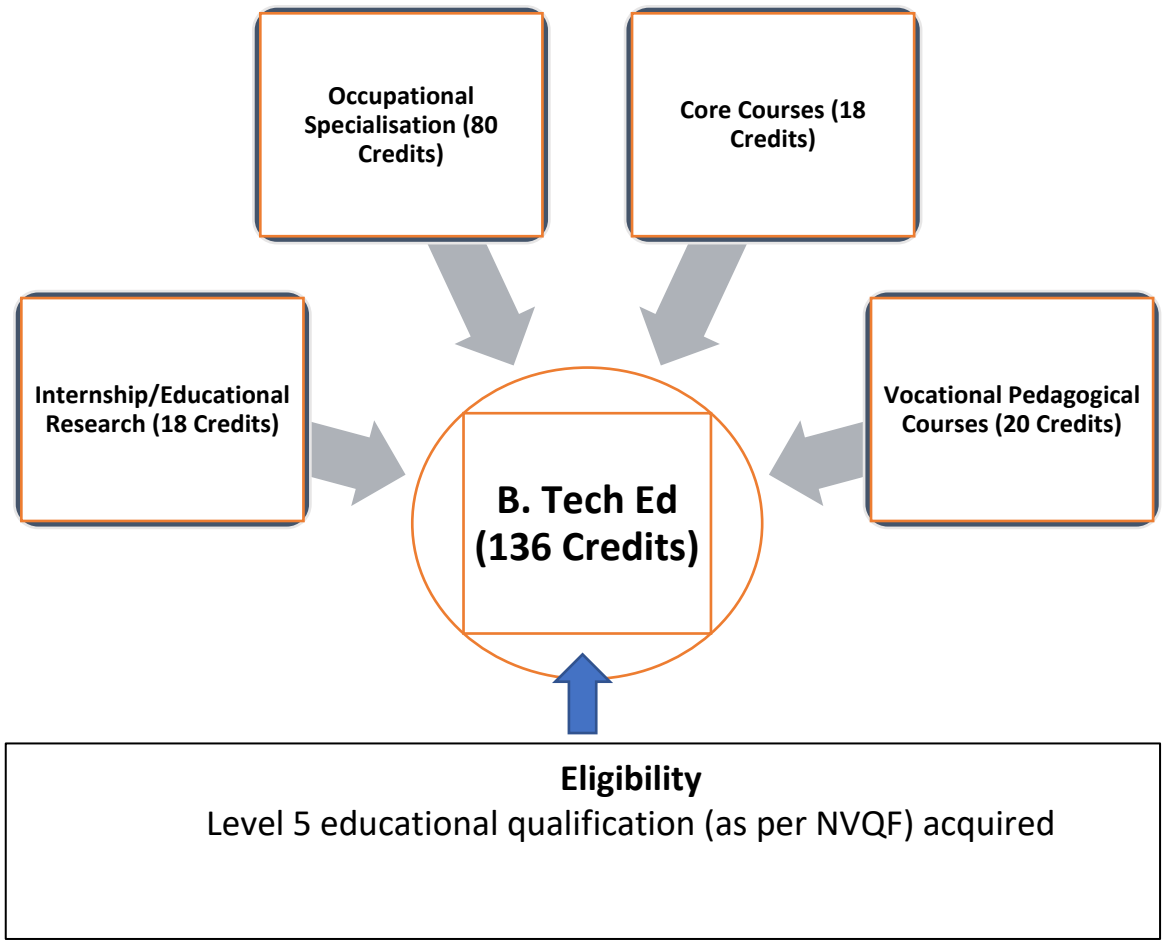
1. Demonstrate Level 6 competencies envisaged by the National Vocational Qualification Framework (NVQF) of Nepal,
2. Exhibit comprehensive, meaningful, and coherent knowledge and skills in any of the specific fields in technical-vocational occupational specialization e.g., civil, mechanical, computer, agriculture, etc,
3. Apply occupational specialization knowledge and skills in solving problems occurred in their contexts of work,
4. Apply vocational pedagogical knowledge and skills in any of the specific fields in technical and vocational instruction,
5. Show scholarly literacy, communication, quantitative reasoning, critical thinking, learning skills needed for advanced learning,
6. Exemplify a deep and principled understanding of the technical and vocational learning processes and the role of the instructors in facilitating these processes in the students,
7. Show a sound understanding of how educational processes relate to larger historical, social, cultural, and political processes,
8. Apply a wide range of teaching process skills including curriculum development, lesson planning, materials development, assessment, and pedagogical approaches, and
9. Reflect on the relationship between teaching and learning, content and pedagogy, work and learning, thereby embracing lifelong learning in their roles as the technical and vocational instructors

The Program has been divided into eight semesters. The total credit hours of the Program are 136. At the end of each semester, there will be a semester assessment. However, according to Kathmandu University rule, the total duration to complete the Program must not exceed seven years.

Normally, graduates of the B Tech Ed Program are eligible for master-level studies (equivalent to Level 7) in technical and vocational education, teacher education, general management, technology management, educational leadership, TVET management, rural technology, to name but a few.

Bachelor of Technical Education

Program Structure



Entry Requirements

The minimum prerequisite for this program is the completion of Level 5 education in relevant vocational specializations. The details are-

- PCL equivalent diploma or an intermediate in a technical subject (≥ 2nd division) from a recognized institute with SLC (≥ 2nd division); or
- A two-year technician certificate (≥ 50%) from a recognized institute with SLC (≥ 2nd division); or
- An intermediate level in a technical subject (≥ 2nd division) from a recognized institute with TSLC (≥ 50%);
- A 2-year technician certificate from a recognized institute (≥ 50%) with TSLC (≥ 50%); or
- 10+2 or equivalent (SLCE after 2016) with sufficient background/experience for the area of vocational specialization.

General Educational Knowledge test (oral and written): This is a written objective test to assess the applicant's knowledge in Mathematics, Science, and English corresponding to intermediate/10+2/diploma levels. Those who secure 50% can be eligible for the study.

Oral/Occupational assessment (test): This assessment focuses on the applicant's aptitude, related work experience, career goals, personal presentation skills, and financial support. Those who secure 50% will qualify for the study.

Core Courses (18 Credit Hours = 12 TH + 6 PR)

SN	Courses	Credit Hours	Theory	Practical
1.	EDUC 100 The Teaching Profession	3	2	1
2.	ENGT 100 General English	3	2	1
3.	EDUC 200 Educational Psychology	3	2	1
4.	NEPL 200 General Nepali	3	2	1
5.	EDUC 300 Curriculum Development	3	2	1
6.	EDUC 301 Measurement and Evaluation	3	2	1
Total		18	12	6

EDUC = Education, COME = Communication English, COMN = Communication Nepali

CORE Course Outline for Semester 1

Course**:** The Teaching Profession | Code: EDUC 100

Credit Hours: 3 | Nature: Theory and Practical

Course Description

Teaching is a noble profession through which teachers facilitate students' learning to construct knowledge and develop skills to meet the goals of education. A teacher inspires and empowers students through the proper use of 'Hand, Heart and Mind'. For this, a teacher needs to develop professional knowledge and skills through experience and formal education. One of the essential features among teachers is that they should be acquainted with different philosophical orientations of teaching professions to develop their professions as per the demanding need of the local and global contexts and develop their better version. In this context, this course is designed to illustrate the various evolution of the teaching profession in different cultures and civilizations. In this, students will be acquainted with the professional standards of the teaching profession to be better teachers.

Similarly, students will develop a sound understanding of teaching as mentoring and coaching. Moreover, it is necessary to identify and explore different models (reflective practice) of the development of the teaching profession. So, this course will be beneficial for everyone who can see themselves being a professional teacher with knowledge and skills of various teaching professional features.

Learning Outcomes

- Develop a sound understanding of different philosophical orientations of teaching professions in the local and global contexts
- Exhibit skills of teaching as a process of continuous growth and development of teachers through reflective practice
- Demonstrate the roles of teacher as mentor and coach
- Appraise professional standards of the teaching profession

Unit/Module Outlines

Modules/Units	Descriptions
Philosophical Foundation and	• Historical root of teaching profession • Teacher in classical and modern times

Evolution of Teaching Profession	• Teacher as expert, facilitator and change agent Source: https://www.sciencedirect.com/science/article/pii/S1877042816000549
Professional Standards for Teachers	• Knowing students • Knowing contents and methods • Plan and implement teaching effectively • Developing and maintaining safe learning environment • Assessing students and providing feedback for better learning • Continuing professional learning • Working professionally with communities and beyond Source: https://www.aitsl.edu.au/docs/default-source/national-policy-framework/australian-professional-standards-for-teachers.pdf
Models of Teacher Professional Development	• The action research model • The reflective practice/cycle model • The lifelong learning model • The currere model Source: https://www.tandfonline.com/doi/abs/10.1080/09751122.2015.11890375
Teacher in the 21st Century	• Transmitter and facilitator • Cultural reproducer and change agent • Facilitator of values clarification • Teacher as learner and researcher Source: https://journals.sagepub.com/doi/full/10.1177/1745499919829214
References	Buchanan, J. (2020). *Challenging the Deprofessionalisation of Teaching and Teachers*. Springer Singapore. Monteiro, A. R. (2015). *The teaching profession: Present and future* (pp. 47-60). Dordrecht: Springer International Publishing.

(Vocational Pedagogical Courses (20 Credit Hours = 10 Th + 10 Pr)

Courses	Credit Hours	Theory	Practical
1. VPED 100 Principles and methods of technical instruction (2)	2	1	1
2. VPED 101 Instructional System Design (2)	2	1	1
3. VPED 210 Instructional Skills (I)	2	1	1
4. VPED 220 Instructional Skills (II)	2	1	1
5. VPED 300 Designing Occupational Curriculum (2)	2	1	1
6. VPED 301 TVET Ecosystem in Nepal (2)	2	1	1
7. VPED 302 Training Methodology (2)	2	1	1
8. VPED 303 Assessment in TEVT (2)	2	1	1
9. VPED 400 Materials Development in TVET (2)	2	1	1
10. VPED 401 Enterprise Development (2)	2	1	1
Total	20	10	10

VPED = Vocational Pedagogy

VOCATIONAL PEDAGOGICAL Courses Outline for Semester 1

Course**:** Principles and methods of technical instruction (2) Code: VPED 100

Credit Hours: 2 Nature: Theory and Practical

Course Description

This course is designed to provide theoretical and practical exposure to students in planning teaching, learning, and evaluation by applying various methods based on the subject matter. It helps develop a sound understanding to get to know the learners in terms of their background, prior learning, sociocultural contexts, etc. Similarly, the course also centralizes its goal to help students locate and acquire the resources: dry and wet labs, studios, maker space, workshop, etc. Moreover, another primary focus is to help students be aware of impending difficulties, questions, disruptive behavior, conflicts, and ways of handling them by being mindful of different learning difficulties the learners face in skills development. Also, the course focuses on promoting independent learning among the learners through self-discovery, problem-solving, and product development.

Learning Outcomes

- Demonstrate a sound understanding of various technical instructions
- Apply various methods while planning for teaching and evaluation
- Explore multiple strategies to understand students based on their background, prior learning, sociocultural contexts
- Compare and contrast among various resources
- Explore ideas to handle the behaviors of students
- Develop skills in being mindful of different learning difficulties faced by learners and help them to progress
- Apply the principles of making students independent learners
- Develop lessons that use transversal skills for their vocational areas

Module/Unit Outlines

Modules/Units	Descriptors
Introduction to Technical Instruction	• Methods and orientations, • Experiential learning of John Dewey • Developing competencies and outcomes

	• Developing tasks and activities Source: https://eacea.ec.europa.eu/national-policies/eurydice/content/teaching-and-learning-vocational-and-technical-upper-secondary-education_en
Understanding Students in Educational Instruction	• Developing students' profiles • Assessing prior knowledge • Planning for remedial instruction • Addressing diversities as asset Source: https://www.nap.edu/read/5287/chapter/9
Resource Materials for the Instructional Activities	• Projected and non-projected materials for technical instruction • Instructional media • Apps and Learning Management System Source: https://teaching.unl.edu/course-design/flex-hybrid/instructional-materials/
Classroom Management	• Management for efficiency and management for equity • Promoting participation • Ensuring the success for all -reaching out to all Source: https://web.calstatela.edu/faculty/jshindl/cm/Chapter11pedagogy-final.htm
Work and learning	• Situated Learning: Work as context for learning • Complexity of work and learning • Different forms of work-based learning • Developing work-based learning modules https://doi.org/10.1108/13665621311316447
Transversal Skills for technical and vocational education	• The 4 C framework—Communication, Critical Thinking, Creativity and Collaboration • The blend of soft and hard skills • Integrating transversal skills for TVET lessons

	Source https://bangkok.unesco.org/content/transversal-skills-tvet-pedagogies-and-assessment
References	Rus, R. C., Husain, M. A. M., Hanapi, Z., & Mamat, A. B. (2020). TVETagogy: Teaching and Facilitating Framework (PDPC) for Technical and Vocational Education and Training (TVET). *International Journal 0f Academic Research In Business And Social Sciences*, *10*(3). Pavlova, M., & Chen, C. S. (2019). Facilitating the development of students' generic green skills in TVET: an ESD pedagogical model. *TVET@ Asia*, *12*, 1-21. Maclean, R., & Wilson, D. (2009). *International handbook of education for the changing world of work: Bridging academic and vocational learning* (Vol. 1). C. A. Chinien (Ed.). Dordrecht: Springer Netherlands.

Mechanical Engineering- General (80 Credit Hours = 32 Th + 48 PR)

SN	Courses	Th	PR	Total Credits
1.	CEEX 201 Strength of Materials (3)	1	2	3
2.	EGEX 100 Engineering Drawing I (2)	1	1	2
3.	EGEX 110 Engineering Drawing II (2)	1	1	2
4.	EGEX 111 Engineering Mathematics I (2)	1	1	2
5.	EGEX 120 Engineering Mathematics II (2)	1	1	2
6.	EGEX 200 Engineering Mechanics (3)	2	1	3
7.	ELEX 100 Basic Electrical Engineering (3)	2	1	3
8.	ENEX 100 Basic Electronics (3)	2	1	3
9.	MEEX 202 Engineering Thermodynamics (3)	2	1	3
10.	MEEX 220 Advanced Manufacturing Process (3)	1	2	3
11.	MEEX 310 Metal Cutting and Forming (3)	2	1	3
12.	MEEX 311 Computer-Aided Manufacturing (3)	0	3	3
13.	MEEX 100 Basic Mechanical Engineering (3)	2	1	3
14.	MEEX 110 Basic Manufacturing Process (3)	1	2	3
15.	MEEX 111 Material Science & Metallurgy (3)	1	2	3
16.	MEEX 112 Computer-Aided Design I (3)	1	2	3
17.	MEEX 200 Theory of Machine (3)	2	1	3
18.	MEEX 210 CAD and FEA (3)	2	1	3
19.	MEEX 211 Machine Design I (3)	1	2	3
20.	MEEX 212 Fluid Mechanics (3)	2	1	3
21.	MEEX 221 Computer-Aided Design II (3)	1	2	3
22.	MEEX 240 Mechanical Workshop (Lab.) (2)	0	2	2
23.	MEEX 312 Heat Transfer (3)	1	2	3
24.	MEEX 313 Casting and Welding of Metals (3)	0	3	3
25.	MEEX 320 Machine Design II (3)	0	3	3
26.	MEEX 340 Project I (3)	0	3	3
27.	MEEX 330 Elective I (2)	1	1	2
28.	MEEX 331 Elective II (2)	1	1	2
29.	MEEX 499 Project II	0	3	3
	Total	32	48	80

ENEX = Electronics Engineering Education Extension Course

MEEX = Mechanical Engineering Education Extension Course,

AEEX = Automobile Engineering Education Extension Course,

ELEX = Electrical Engineering Education Extension Course

Semester-wise Course Distribution -- B Tech Ed (Mechanical Engineering-General)

Year	Semester	Educational Core and Research (21)	Vocational Pedagogy/Research and Internship (20)	Mechanical-General	Total
1	I	EDUC 100	VPED 100	EGEX 100 MEEX 100 ELEX 100 MEEX 110 EGEX 111	18
	II	ENGT 100	VPED 101	ENEX 100 EGEX 110 MEEX 111 MEEX 112 EGEX 120	18
2	III	EDUC 200	VPED 210	EGEX 200 MEEX 200 MEEX 210 MEEX 211 MEEX 221	19
	IV	NEPL 200	VPED 220	CEEX 201 MEEX 202 MEEX 211 MEEX 212 MEEX 220	20
3	V	EDUC 300	VPED 300 VPED 301	MEEX 310 MEEX 320 MEEX 312 MEEX 340	19
	VI	EDUC 301	VPED 302 VPED 303	MEEX 311 MEEX 313 MEEX 330 MEEX 331	17
4	VII	EDUC 421	VPED 400 VPED 441	MEEX 499	14
	VIII		VPED 401 VPED 442 VPED 499		11
Total					136

The course outlines of the Mechanical Engineering -- General) components of B Tech Ed (Mechanical Engineering-General) for Semester One are overleaf and the descriptions of all courses are in Annex - D

MECHANICAL ENGINEERING-GENERAL Courses Outline for Semester 1

Course: Engineering Drawing I Code: EGEX 100

Credit Hours: 2 Nature: Practical

Course Description

This is an introductory drawing course. The course includes fundamental knowledge and skills such as line work, lettering, scale use, sketching, multi-view drawings, sectional views, and the basics of manual drafting techniques and drafting equipment.

Objectives/Learning Outcomes

- Illustrate the use of dimensions and engineering scale
- Get acquainted with the terminologies used in Engineering drawing
- Draw primary engineering curves such as ellipse, parabola, hyperbola and spirals
- Demonstrate the orthographic projection skills

Unit/Module 1

Introduction of Engineering Drawing and Instruments Used in Engineering Drawing: E.g., Drafter, types of Pencil, set squares, etc. The layout of Drawing Sheets, Types of Lines, Lettering Layout and lettering Practice.

Dimensioning

Unit of Dimensions, System of Dimensioning, Shape identification Dimensioning

Engineering Scale

Representative Factor, Construction and Types of Scales, Plain Scales, Diagonal Scales, Vernier Scales, Comparative Scales, Scale of Chords

Geometrical Constructions:

To divide the lines into any number of equal parts, to divide a given angle into even number of divisions. To draw an arc tangential to a line and passing through a point., Construction of regular polygons.

UNIT/MODULE 2

Introduction of Engineering Curves

The terminology used in Engineering Curves and a brief discussion about types and applications of Engineering Curves.Definition and Terminology of Conic Section, Applications, Construction of Conic Sections,

Ellipse: Definition and Terminology, Applications, finding out foci when Major and Minor axis are given, Drawing Tangents to Ellipse at a point on the ellipse or from a point outside the ellipse.

Different Methods of Construction of Ellipse:

- Pin and Thread Method
- Intersecting Method
- Rectangle Method
- Circle Method
- Trammel Method
- Concentric circle Method
- Parallelogram Method
- Four centers approximate Method

Parabola: Definition, Terminology and Applications, to find the axis, focus and directrix of a Parabola. Drawing Tangents to the Parabola either at a point on the Parabola or from a point outside the Parabola

i. When the focus and directrix are given

ii. When the focus and directrix are not given

Different methods of construction of Parabola

i. Rectangle Method

ii. Parallelogram Method

iii. Tangent Method

Hyperbola: Definition, Terminology and Applications, Drawing Tangents to the Hyperbola either at a point on the Hyperbola or from the point outside the Hyperbola, Different Methods of construction of Hyperbola, Definition and construction of Rectangular Hyperbola,

Involutes: Definition and Terminology, Applications, Drawing Tangent and Normal at a point on Involutes, Definition and Construction of Involutes by

- Involute of a line
- Involute of a Triangle
- Involute of a Polygon

Spirals: Definition and Terminology, Applications, Definition and Construction of Archemedian and Logarithmic Spirals, Drawing Tangent and Normal at a point on Spirals

Cycloidal Curves:

Definition and Terminology, Applications, Definition and Construction of Epicycloid and Hypocycloid

Drawing Tangent and Normal at a point on Cycloidal Curves, Definition, Terminology and Applications of Trochoid, Epitroichoid and Helix

UNIT/ MODULE 2: Orthographic Projections

Projection of an Object, Principal Views and Principal Planes of Projection, Four Quadrants and System of Projection, First angle and Third angle Projection, Difference between them and their advantages, Symbols of Projection, Projection of Points, Projection of Lines, Definition, True length and True Inclination of a Line

Line Parallel to both the Planes, Line Parallel to one Plane and Perpendicular to Other plane, Line Parallel to one Plane and Inclined to Other, Line Inclined to both Horizontal and Vertical plane, Convention for Line Thickness

Projection of Plane Surfaces: Definition, True shape of a plane surface, Plane surface parallel to one of the Principal Planes and Perpendicular the other two, Plane Surfaces Perpendicular to one of the three Principle Planes and Inclined to other two, Plane Surfaces Inclined to all the three Principal Planes of Projection

Projection of Solids: Definition of Solids, Classification of Solids e.g. Polyhedrons, Prisms, Pyramids), Projection of Solids Placed in different positions, Axis of the Solid Perpendicular to HP,

Axis of the Solid Perpendicular to VP, Axis of the Solid Perpendicular to HP and Parallel to VP, Axis of the Solid Inclined to VP and Parallel to HP,Axis of the Solid Inclined to both HP and VP, Methods of Solving the Problems of Cubes, Cones, Prisms, Cylinders, Pyramids Surface Development: Methods of Development, Parallel Line Development, Radial Line Development, Triangulation Development, Approximate Development

MECHANICAL ENGINEERING-GENERAL Courses Outline for Semester 1

Course**:** Engineering Mathematics I Code: EGEX 111

Credit Hours: 2 Nature: Theory and Practical

Course Description

To provide enough mathematical facts to cope with a wide variety of engineering problems. The course is not overloaded with scrupulous proof, which has little practical application. The course demands explaining the fundamental ideas and showing how they are applied in different other disciplines mentioned above.

Course Objectives/Learning Outcomes

1. Illustrate the use of differential calculus in a variety of contexts such as finding the rate of change, continuity, maximum and minimum values
2. Demonstrate the application of integral calculus in finding the area, volume, length of the path, etc.
3. Exhibit the use of convergent and divergent series in **the directional relationship of two trends, prices, or indicators**
4. Apply determinants and matrix to solve the system of linear equations

Unit/Module 1 Differential Calculus

Increments: Average and instantaneous rates of change, The slope of a curve y = f(x) Derivatives as the instantaneous rate of change, Velocity and other rates of change.

Limits and continuity: Properties of limits, One sided limits, existence of limit at a given point, Infinity as a limit, Limits of exponential and logarithmic functions, Types of discontinuity.

Differentiation: Formal definition, Polynomial functions and their derivatives, Product, Power and quotient rules, Implicit differentiation and fractional power, The chain rule and parametric equations, Angle between two curves, Derivatives of trigonometric functions, Differentials

Applications of derivatives: Curve sketching, The sign of first derivatives, Concavity and points of inflection, Asymptotes and symmetry, Maxima and minima; Theory and problems

Related rates, Roll's Theorem and Mean value theorem, Indeterminate forms L-Hospital's rule, Extending the Mean value theorem to Taylors formula

Unit/Module 2 Integral Calculus

Integration: Introduction, Indefinite integration, Applications of determining constants of integration, Integrals of trigonometric functions, Definite integrals; The area under a curve

Calculating areas as limits,the fundamental theorem of integral calculus, Integration by substitution, Differentials.

Integration methods: Basic integration formulas, Integration by parts, Product and powers of

trigonometric functions, Even powers **Integration methods:** Basic integration formulas, Integration by parts, Product and powers of trigonometric functions, Even powers of sines and cosine trigonometric substitutions in integrals involving a2+u2 and integrals involving ax^2+bx+c

Partial fractions ,The substitution; z = tan(x/2), Improper integrals.

Application of Definite integrals: Area between two curves, Distance Calculating volumes by slicing, Length of a plain curve, Area of a surface of revolution, Average value of a function

Module/Unit 3 Sequence and Series

Sequence and infinite Series: Sequence of numbers, Limits that arise frequently, Infinite series, Test for convergence of series with non-negative terms, Absolute convergence, Alternating series, Conditional convergence.

Module/Unit 4 System of Linear Equations, Matrix and Determinants

Systems of linear equations: Row operation method and Gaussian elimination, reduced echelon form, Consistency and row rank, Matrix representation of linear system, Solutions of linear systems

Matrix and Determinants: Matrix operations, Special types of matrices, The inverse of a matrix, Properties of determinants, Rank of a matrix, Applications of matrices and determinants

References:

1. Thomas & Finney, Calculus and Analytical Geometry, Sixth edition Narosa Publishing House New Delhi

2. J.W.Brown & D.R. Sherbert, Introductory Linear Algebra

3. D.T.Finkbeiner,Introduction to Matrices and Linear Transformations 3rd edition CBS publisher anddistributors, Delhi.

MECHANICAL ENGINEERING- General Courses Outline for Semester 1

Course**:** Basic Mechanical Engineering | Code: MEEX 100

Credit Hours: 3 | Nature: Theory and Practical

Course description:

The course introduces students to basic mechanical engineering about statics, dynamics, thermodynamics, fluid mechanics, and heat transfer.

Objectives/Learning Outcomes

- Develop acquaintance with basic concepts of mechanical engineering such as statics, dynamics, fluid mechanics, etc.
- Apply these different concepts in real-world contexts, such as designing the machine, performing the artisan works, and other machine-use related situations
- Demonstrate the use of fundamental mechanical engineering concepts by showing examples of locally available machines and/or machine-like objects

Course Outlines

Unit/Module 1: Engineering Statics: equivalent force systems: equilibrium, friction, cables, centre of gravity

Unit/Module 2: Engineering Dynamics: Velocity, acceleration, momentum, Newton's second law of motion, the moment law, work and energy, rotation about a fixed axis

Unit/Module 3: Strength of Materials: concepts of stress, strain, stress-strain diagram, Hook's law

Unit/Module 4: Thermodynamics: properties of substances, the first law of thermodynamics, entropy and second law of thermodynamics, Thermodynamic cycles, gas compression, refrigeration, gas and steam turbines

Unit/Module 5: Fluid Mechanics: introductory concepts, fluid in motion, continuity equation, mass conservation, viscosity, Bernoulli's equation, boundary layer, laminar and turbulent flow, turbomachines, momentum, impulse turbine, axial flow and centrifugal, machines, hydraulic turbines.

Unit/Module 6: Heat Transfer: steady-state and transition heat conduction, one-dimensional and two-dimensional heat flow, heat transfer by radiation, convective heat transfer, free and forced convection.

References:

1. F Krieth: Principles of Heat Transfer Harper & Row
2. I H Shames: Engineering Mechanics Statics and Dynamics (SI Version),PHI
3. J R Howell & R U Buckins: Fundamental of Engineering Thermodynamics, McGH.
4. E P Popov : Mechanics of Materials (SI Version) PHI
5. D S Kumar: Fluid Mechanics and Fluid Power Engineering, Katsen Publishing House

MECHANICAL ENGINEERING-GENERAL Courses Outline for Semester 1

Course**:** Basic Electrical Engineering — Code: ELEX 100

Credit Hours: 3 — Nature: Theory and Practical

Course Description

The course provides a foundation in electrical engineering applicable to mechanical engineering students, to impart a basic knowledge of electrical quantities such as current, voltage, power, energy, and frequency to understand the impact of technology in a global and local context.

Objectives/Learning Outcomes

- Develop working knowledge to analyze basic DC and AC circuits used in electrical and electronic devices.
- Explain working principle, construction, applications of DC machines, AC machines & measuring instruments.
- Highlight the importance of transformers in transmission and distribution of electric power.
- Appy the basic electrical engineering knowledge in the context of machical engineering and other contexts

Course Outlines

Unit/Module One: Basic Circuit Theory: Ideal, Non-ideal, Dependent and Independent sources **Resistors:** characteristics (Value, power rating codes, tolerances), current, voltage, power relationship, equivalent resistance in parallel and series connection, temperature coefficient, delta-star connection, Kirchhoffs current and voltage laws, voltage divider and current divider formula, Node and Mesh analysis, solution by determinant and substitution, Superposition theorem. Thevenins and Nortons Theorem and network solution using these theorems, Maximum power transfer to the load in a 2 -port resistive network.

Unit/Module Two: AC Circuit Fundamentals: Generation of AC voltage (brief theoretical introduction of ac machine), Definition of time period, frequency, waveform, phase, phase difference Peak, peak-to-peak, average, RMS or effective value of any type of ac voltage or current waveform

Unit/Module Two: Phasors: phasor algebra, steady state analysis of RLC circuits, Impedance, Admittance, Reactance, Real, reactive and apparent power, power factor. Significance of p. factor, Resonance in series and parallel RLC circuits, Bandwidth, Effect of Q-factor in resonance.

Unit/Module Three: 3-Phase Circuits: Generation of 3-phase, merits of 3-phase over 1-phase generation, Phase sequence (ABC or CBA), Voltage and current phasor in different sequence (i.e. ABC or CBA) Line and phase quantities in Y-connected or Delta connected balanced load, Y-delta equivalence, Power in 3-phase circuits

Unit/Module Four: Magnetic Circuits and Transformers: Revision of electromagnetism. Magnetic field and flux, Magnetic field strength, MMF, permeability of free space. Relative permeability, Introduction to a simple magnetic circuit with air gap, reluctance, presence, and comparison of magnetic circuit with electric circuit. Faradays law of electromagnetic induction, self-inductance and mutual inductance, coupling coefficient, dot convention in electric circuit.

Unit/Module Five: Single Phase Transformers: Construction, principle of operation, ideal transformers, and voltage and current relationship, turn ratio. Operation of relay and solenoid.

Unit/Module Six: Dc-Machines: construction, operation, EMF and torque relations, Series and shunt motor characteristics and performance starting and speed control

Unit/Module Seven: Synchronous Machines: construction, operation, rotating field and characteristics of synchronous machines, mains synchronisation

Unit/Module Eight: Induction Motor: construction and operating principles, basic relations, performance, and single phase induction motor

Principle of the Dc Voltmeter, Ammeter, And Ohmmeter: Voltmeter sensitivity and error correction.

References:

1. R J Smith Circuits Devices and Systems, Wiley Int. Edition, 5th Ed., 1991
2. E Hughes Electrical Technology ELBS, 6th ED., 1987
3. R Del Toro Principles of Electrical Engineering PHI, New Delhi, 1987
4. J Nagrath Basic Electrical Engineering Tata McGraw Hill, Delhi

MECHANICAL ENGINEERING-GENERAL Courses Outline for Semester 1

Course**:** Basic Manufacturing Process Code: MEEX 110

Credit Hours: 3 Nature: Theory and Practical

Course Description

The main goal of this course is to emphasize the importance of manufacturing sciences in day-to-day life and study the basic manufacturing processes and tools used. The course is delineated to understand conventional manufacturing processes like casting, metal forming, and welding.

Objectives/Learning Outcomes

- Develop sound comprehension of lathes, gear, machine tools, metal work and weling in relation to developing acquaintance with machines and their designs
- Apply these different concepts in developing one or more sections/parts of the given machines
- Solve problems related to the manufacturing process that has to do with machines, gear, and metal works

Course Outlines

Unit/Module 1 Lathes:

Introduction to Machine Tools and Classification of Machine Tools,

Lathe: types of lathe, lathe parts, work holding devices: chucks face plate. Lathe operations: facing, turning, drilling, and boring. Taper turning: calculation and problems. Thread cutting; gear calculation; use of dial indicator. Method of cutting multiple threads, thread chaser, cutting metric threads. Eccentric turning. Capstan and turret lathes. Layout of turret tooling.

Unit/Module 2: Shaping, Planning, Slotting & Milling Machines: Gear Generation:

Shaping machine: parts and their functions Principle of crank shaper and hydraulic shaper, speeds and feeds, table-feeding mechanism.

Slotting Machine: description of slotting machines and their function

Planers: types and their relative merits, difference between planer, shaper and slotter.

Milling Machines: types and principles of milling, milling cutter terminology, milling operations, gear cutting, indexing: simple, compound, differential indexing and calculations.

Gear generation methods: gear shaping and gear hobbing

Unit/Module 3: Other Machine Tools

Drilling Machines: types of drilling machines, parts and their functions. Twist drill terminology, machining time calculation.

Boring machines: types & uses. Broaching Machines: types & uses

Grinding Machines: designation of grinding wheel, grinding operations, speeds and feeds, balancing, truing and dressing of grinding wheel, types of wheel shapes, the coolant used.

Unit/Module 4: Metal Work:

True Stress, True Strain, Plastic Deformation, Hot Working, Hot Working Temperatures, Cold Working. Rolling, Principle, Equipment, Angle of Bite, Calculation for slip. Forging, Principle, Flow Stresses, Strain, Extrusion, Principle, Hot & Cold Extrusion, Wire Drawing, Principle, Tube Drawing, Sheet Metal Working, Definitions of Various Operations like Shearing, Blanking, Piercing Trimming, Shaving etc., Forging Hammers and Presses.

Unit/Module 5: Foundry:

Foundry hand tools. Foundry sand and their control additives. Core and types of core.Pattern materials and types of patterns. Shrinkage allowances. Molding process pouring. Knockout and cleaning of casting.Brief description of special casting methods as shell molding, CO2 molding and centrifugal molding, Permeability, hardness, flowability. Tensile compression, shear strength and moisture content. Defects in sand casting.Cupola.

Unit/Module 6: Welding:

Welding: Soldering, brazing and braze welding advantages and limitations.Welding processes and applications. Defects in welding

Gas Welding: Principles, Types of gases used, Types of Flames, Welding Techniques, Filler Rods, Principles Position of Torch, Precautions and Safety

Electric Arc Welding: Principles, A.C./D.C. Welding, Edge Preparation, , Welding Electrodes, Manual Metal Arc Welding, Carbon Arc Welding, Inert Gas Shielded Arc Welding, TIG & MIG, Submerged Arc Welding, Atomic Hydrogen Arc Welding, Plasma Arc Welding, Stud Arc Welding, Arc Cutting.

Resistance Welding: Principles, Electrodes, Spot Welding, Seam Welding, Projection Welding, Upset Welding, Flash Welding.

Fusion Welding Processes: Thermit Welding, Electro Slag Welding, Electron Beam and Laser Beam Welding

References:

1. J.S. Campbell: Principle of manufacturing, TMH Publications & Co.
2. Raghavan: Workshop technology I
3. Raghuwanshi: Workshop technology I, Dhanpatrai & Sons
4. Begman & Amsteed: Manufacturing processes

SK Hajra Choudhary & SK Rose: Elements of workshop technology, Vol. I, Media Publishers.

Internship and Research (18 Credit Hours = 1 Th + 17 Pr)

SN	Courses	Theory	Practical	Total
1	EDUC 421 Educational Research	1	2	3
2	VPED 441 Internship – Teaching/Training	0	6	6
3	VPED 442 Internship – Work-based learning	0	6	6
4	VPED 499 Educational Research Project	0	3	3
	Total	1	17	18

Evaluation Scheme

The evaluation scheme shall follow a continuous assessment system with an ethos of competency-based assessment. Specifically, the practical components shall be assessed in the lab, at the workplace, and/or via a learning portfolio. The theoretical components shall be evaluated via written, oral, demonstration and/or all means. Kathmandu University Grading System will apply.

Graduation Requirements

Individuals completing all of the requirements shown on their approved Planned Program of Study are eligible for graduation. However, the required minimum cumulative grade point average (CGPA) of courses is 2.00 and also in the examination administered by Kathmandu University (See details in "Grading and Certification System").