Department of Mechanical Engineering

Affiliated Engineering College

University of Dhaka

Syllabus for B.Sc. in Mechanical Engineering

Sl. No.	Year/Semester	Theory		Sessional		Total Credit
		No. of Course	Credit	No. of Course	Credit	
1.	1st/1st	5	14.00	6	6.50	20.50
2.	1st /2nd	6	17.00	4	3.75	20.75
3.	2nd /1st	5	15.00	3	3.00	18.00
4.	2nd /2nd	5	15.00	4	3.75	18.75
5.	3rd/1st	5	15.00	5	3.75	18.75
6.	3rd/2nd	6	18.00	5	5.00	23.00
7.	4th/1st	6	18.00	4	4.25	22.25
8.	4th/2nd	5	15.00	1	4.00	19.00
Total		**43**	**127.00**	**32**	**34.00**	**161.00**

Course Designation and Numbering System

Each course is designated by a three letter code (e.g. EEE, MEC, HUM, MAT, CHE, PHY, etc.) identifying the course offering department followed by a four-digit number with the following criteria:

1. The first digit will correspond to the year in which the students normally take the course.
2. The second digit will correspond to the Term (1 for 1st Term, 2 for 2nd Term and 0/1/2 for both Terms in case of optional courses only) in which the course is normally taken by the students.
3. The third and fourth digits will be reserved for departmental use, of which the last digit will be odd for theoretical and even for sessional/laboratory courses.
4. The course designation system is illustrated by the following example:

MEC 1201 Thermodynamics

MEC: Departmental identification code (Mechanical Engineering).

1: The first digit signifies the year (First year).

2: The second digit signifies the Term number (1 for 1st Term. 2 for 2nd Term and 0/1/2 for both Terms in case of optional courses only).

01: 3rd and 4th digits are reserved for departmental use. The last digit designates a course (odd No. for theoretical and even No. for sessional/laboratory course).

Thermodynamics: Course Title

N.B: There will be one blank space after the Departmental Identification code

5. Project/thesis courses shall be designated by departmental identification code followed by 4000 (Example: MEC 4000 applicable for both the Terms).

Pre-Requisite Courses

Some of the core courses are identified as pre-requisite courses. A pre- requisite course is one that is required to be completed/appear at the examination before some other course(s) can be taken. Any such course, on which one or more subsequent courses built up, may be offered in each of the two regular terms (if possible).

Optional Courses

Apart from the core courses, a student will have to take a number of courses which he/she can choose from a specified group/number of courses to complete the credit requirements.

Abbreviation	Elaboration
MAT	Mathematics
CHE	Chemistry
PHY	Physics
HUM	Humanities
MEC	Mechanical Engineering
EEE	Electrical & Electronic Engineering
CSE	Computer Science and Engineering
MES	Mechanical Engineering Shop

Summary of the Courses

1st Year 1st Semester

SI. No.	Course No.	Course Title	Contact hours/week	Credits
1.	MAT 1101	Mathematics-I	3	3.00
2.	HUM 1101	Functional English	2	2.00
3.	PHY 1101	Physics-I	3	3.00
4.	CHE 1101	Engineering Chemistry	3	3.00
5.	EEE 1101	Electrical Circuits Analysis	3	3.00
6.	HUM 1102	Sessional on HUM 1101	3/2	0.75
7.	PHY 1102	Sessional on PHY 1101	3/2	0.75
8.	CHE 1102	Sessional on CHE 1101	3/2	0.75
9.	EEE 1102	Sessional on EEE 1101	3/2	0.75
10.	MEC 1100	Engineering Drawing	3	1.50
11.	MES 1102	Workshop Practice	4	2.00
		Total:	**27.00**	**20.50**

1st Year 2nd Semester

SI. No.	Course No.	Course Title	Contact hours/week	Credits
1.	MAT 1201	Mathematics-II	3	3.00
2.	PHY 1201	Physics-II	3	3.00
3.	HUM 1201	Bangladesh Studies	2	2.00
4.	EEE 1201	Electrical Machines & Semiconductor Devices	3	3.00
5.	MEC 1201	Thermodynamics	3	3.00
6.	CSE 1201	Introduction to Computer Programming	3	3.00
7.	PHY 1202	Sessional on PHY 1201	3/2	0.75
8.	EEE 1202	Sessional on EEE 1201	3/2	0.75
9.	MEC 1202	Sessional on MEC 1201	3/2	0.75
10.	CSE 1202	Sessional on CSE 1201	3	1.50
		Total:	**24.50**	**20.75**

2nd Year 1st Semester

SI. No.	Course No.	Course Title	Contact hours/week	Credits
1.	MAT 2101	Mathematics-III	3	3.00
2.	HUM 2101	Economics & Accounting	3	3.00
3.	MEC 2103	Engineering Mechanics - I	3	3.00
4.	MEC 2105	Engineering Metallurgy	3	3.00
5.	MEC 2107	Statistics & Quality Control	3	3.00
6.	MEC 2104	Sessional on MEC 2103	3/2	0.75
7.	MEC 2106	Sessional on MEC 2105	3/2	0.75
8.	MEC 2100	CAD/CAM	3	1.50
		Total:	**21.00**	**18.00**

2nd Year 2nd Semester

SI. No.	Course No.	Course Title	Contact hours/week	Credits
1.	MAT 2201	Mathematics-IV	3	3.00
2.	HUM 2201	Industrial Environment & Sociology	3	3.00
3.	MEC 2203	Engineering Mechanics -II	3	3.00
4.	MEC 2209	Mechanics of Solid	3	3.00
5.	MEC 2211	Measurement & Industrial Instrumentation	3	3.00
6.	MEC 2204	Sessional on MEC 2203	3/2	0.75
7.	MEC 2210	Sessional on MEC 2209	3/2	0.75
8.	MEC 2212	Sessional on MEC 2211	3/2	0.75
9.	MEC 2200	Simulation & Modelling	3	1.50
		Total:	**22.50**	**18.75**

3rd Year 1st Semester

SI. No.	Course No.	Course Title	Contact hours/week	Credits
1.	MEC 3101	Heat and Mass Transfer	3	3.00
2.	MEC 3103	Theory of Machine	3	3.00
3.	MEC 3113	Machine Tools & Tool Engineering	3	3.00
4.	MEC 3115	Fluid Mechanics - I	3	3.00
5.	MEC 3117	Numerical Computation for Mechanical Engineers	3	3.00
6.	MEC 3102	Sessional on MEC 3101	3/2	0.75
7.	MEC 3104	Sessional on MEC 3103	3/2	0.75
8.	MEC 3114	Sessional on MEC 3113	3/2	0.75
9.	MEC 3116	Sessional on MEC 3115	3/2	0.75
10.	MEC 3118	Sessional on MEC 3117	3/2	0.75
		Total:	**22.50**	**18.75**

3rd Year 2nd Semester

SI. No.	Course No.	Course Title	Contact hours/week	Credits
1.	MEC 3201	Heat Transfer Equipment Design	3	3.00
2.	MEC 3215	Fluid Mechanics - II	3	3.00
3.	MEC 3219	Manufacturing Process	3	3.00
4.	MEC 3221	Machine Design - I	3	3.00
5.	MEC 3223	Operation Management	3	3.00
6.	MEC 3225	Research Methodology & Scientific Research	3	3.00
7.	MEC 3202	Sessional on MEC 3201	3/2	0.75
8.	MEC 3216	Sessional on MEC 3215	3/2	0.75
9.	MEC 3220	Sessional on MEC 3219	3/2	0.75
10.	MEC 3222	Sessional on MEC 3221	3/2	0.75
11.	MEC 3200	Integrated Project Design	4.00	2.00
		Total:	**28.00**	**23.00**

4th Year 1st Semester

SI. No.	Course No.	Course Title	Contact hours/week	Credits
1.	MEC 4101	Internal Combustion Engine	3	3.00
2.	MEC 4115	Fluid Machineries	3	3.00
3.	MEC 4121	Machine Design - II	3	3.00
4.	MEC 4127	Refrigeration & Air - Conditioning	3	3.00
5.	MEC 40XX	Optional Course - I	3	3.00
6.	MEC 40XX	Optional Course - II	3	3.00
7.	MEC 4102	Sessional on MEC 4101	3/2	0.75
8.	MEC 4116	Sessional on MEC 4115	3/2	0.75
9.	MEC 4122	Sessional on MEC 4121	3/2	0.75
10.	MEC 4000	Project & Thesis - I	4	2.00
		Total:	**26.50**	**22.25**

4th Year 2nd Semester

SI. No.	Course No.	Course Title	Contact hours/week	Credits
1.	MEC 4229	Renewable Energy Technology	3	3.00
2.	MEC 4231	Power Plant Engineering	3	3.00
3.	MEC 4233	Industrial Management & Professional Ethics	3	3.00
4.	MEC 40XX	Optional Course - III	3	3.00
5.	MEC 40XX	Optional Course - IV	3	3.00
6.	MEC 4000	Project & Thesis - II	8	4.00
		Total:	**23.00**	**19.00**

Total Credit (8 Terms): 161.00

Course Summary

Course Type	Semester	Theory (Credit)	Sessional (Credit)	Total (Credit)
Core Course	1st year 1st semester	0	3.50	3.50
	1st year 2nd semester	3	0.75	3.75
	2nd year 1st semester	9	3.00	12.00
	2nd year 2nd semester	9	3.75	12.75
	3rd year 1st semester	15	3.75	18.75
	3rd year 2nd semester	18	5.00	23.00
	4th year 1st semester	12	4.25	16.25
	4th year 2nd semester	9	4.00	13.00
	Sub Total	**75**	**28.00**	**103.00**
Elective Courses	4th year 1st semester	6	0	6
	4th year 2nd semester	6	0	6
	Sub Total	**12**	**0**	**12.00**
Allied Engineering Courses	1st year 1st semester	3	0.75	3.75
	1st year 2nd semester	6	2.25	8.25
	Sub Total	**9**	**3.00**	**12.00**
General Science Courses	1st year 1st semester	9	1.50	10.50
	1st year 2nd semester	6	0.75	6.75
	2nd year 1st semester	3	0	3.00
	2nd year 2nd semester	3	0	3.00
	Sub Total	**21**	**2.25**	**23.25**
General Education Courses	1st year 1st semester	2	0.75	2.75
	1st year 2nd semester	2	0	2.00
	2nd year 1st semester	3	0	3.00
	2nd year 2nd semester	3	0	3.00
	Sub Total	**10**	**0.75**	**10.75**
Total		**127**	**34.00**	**161.00**

Prerequisite Course

SI. No.	Course No.	Course Title	Prerequisite Course No. and Title
1.	MEC 2100	CAD/CAM	MEC 1100; Engineering Drawing
2.	MEC 2200	Simulation & Modeling	MEC 2100; CAD/CAM
3.	MEC 2209	Mechanics of Solid	MEC 2103; Engineering Mechanics - I
4.	MEC 2203	Engineering Mechanics - II	MEC 2103; Engineering Mechanics - I
5.	MEC 3215	Fluid Mechanics - II	MEC 3115; Fluid Mechanics - I
6.	MEC 3117	Numerical Computation for Mechanical Engineers	MEC 1201; Introduction to Computer Programming
7.	MEC 3103	Theory of Machine	MEC 2203; Engineering Mechanics - II
8.	MEC 4231	Power Plant Engineering	MEC 1201; Thermodynamics
9.	MEC 3201	Heat Transfer Equipment Design	MEC 3101; Heat and Mass Transfer
10.	MEC 4101	Internal Combustion Engine	MEC 1201; Thermodynamics
11.	MEC 4115	Fluid Machineries	MEC 3215; Fluid Mechanics - II

Optional Courses

SI. No.	Course No.	Course Title	Contact Hour	Credit
1.	MEC 4035	Advanced Thermodynamics	3	3
2.	MEC 4037	Automobile Engineering	3	3
3.	MEC 4039	Aerodynamics	3	3
4.	MEC 4041	Fluid Power Transmission and Control	3	3
5.	MEC 4043	Finite Element Method	3	3
6.	MEC 4045	Industrial Automation	3	3
7.	MEC 4047	Operations Research	3	3
8.	MEC 4049	Material Handling & Maintenance Engineering	3	3
9.	MEC 4051	Engineering Tribology	3	3
10.	MEC 4053	Modern Manufacturing Processes	3	3
11.	MEC 4055	Artificial Intelligence	3	3
12.	MEC 4057	Robotics & Mechatronics	3	3
13.	MEC 4059	Mechanical Vibration	3	3
14.	MEC 4061	Nanomaterial & Nanotechnology	3	3
15.	MEC 4063	Industrial Safety	3	3
16.	MEC 4065	Project Management and Leadership	3	3
17.	MEC 4067	Nuclear Power Plant Engineering	3	3
18.	MEC 4069	Power Plant Economics	3	3

Detailed Outline of Undergraduate Courses

1st Year 1st Term

MAT 1101

Mathematics - I

(Credit: 3.00)

Differential Calculus: Continuity and Differentiation, Differentiation of explicit and implicit functions and parametric equations, Successive differentiation of various types of functions, Leibnitz's theorem. Expansion of Function, Rolle's theorem, mean value theorem, Taylor's theorem in finite and infinite forms, Maclaurin's theorem in finite and infinite forms, Lagrange's form of reminder, Cauchy's form of reminder. Partial differentiation, Euler's theorem. Evaluation of indeterminate forms by L'Hospital's rule. Tangent and normal, subtangent and subnormal in Cartesian and polar coordinates, pedal equation. Determination of maximum and minimum values of functions, point of inflexion and its properties. Asymptotes. Curvature, radius of curvature, centre of curvature and chord of curvature

Integral calculus: Definition of integration, integration by the method of substitution, integration by parts, standard integrals, integration by the method of successive reduction. Definite integral and its properties and use in summation of series. Walli's formula, Improper integral, beta function and gamma function. Area under a plane curve in Cartesian and polar coordinates, area of the region enclosed by two curves in Cartesian and polar coordinates. Arc length of curves in Cartesian and polar coordinates, parametric and pedal equations, intrinsic equation. Volumes of solid of revolution, volume of hollow solids of revolution by shell method, area of surface of revolution.

Reference Book:

1. Avez, André. Differential calculus. Courier Dover Publications, 2020.

2. Das, B. C., and B. N. Mukherjee. "Integral calculus." (2018).

HUM 1101

Functional English

(Credit: 2.00)

Vocabulary and Structure: Better reading skills, better writing skills, better speaking skills, word formation; roots prefixes, suffixes, phrases and idioms; synonyms and antonyms; simple structures, complex and compound structure; Clauses, Identification and analysis of clauses.

Comprehension and Composition: Paragraph writing technique, formal and informal report writing, commercial correspondence; Memo, Letter, Application writing, Tender writing, free composition writing, precise writing, Term paper and Thesis writing technique.

Reference Book:

1. Lock, Graham. Functional English grammar: An introduction for second language teachers. Cambridge university press, 1995.

2. Bloor, Thomas, and Meriel Bloor. The functional analysis of English: A Hallidayan approach. Routledge, 2013.

HUM 1102

Sessional on Hum 1101

(Credit: 0.75)

Sessional based on HUM 1101.

PHY 1101

Physics - I

(Credit: 3.00)

Relativity: Special theory of relativity, Reference frames, Michelsion-Moreley experiment, Galilean transformation, Lorentz transformation, Time dilation, Length contraction, Variation of mass, Mass energy relation, Massless particles, Velocity transformation.

Particle Properties of Waves: Photoelectric effect, Quantum theory of light, Compton Effect.

Wave Properties of Particles: De Broglie waves, Phase velocity and Group velocity.

Atomic Structure: Bohr's atom model, Nature of electron orbits, Orbital energy, origin of spectral lines, different series of spectral lines of Hydrogen, Orbital energy level diagram of Hydrogen atom, Magnetic moment of orbital electron, Quantization of magnetic moment, Electron shell.

Solid State Physics: Structure of crystals, Classification of solids, Einstein's model of the lattice, specific heat of the solids, Debye's model of the lattice heat capacity. Debye's approximation of high temperature and low temperature; Outstanding properties of metals, Electrical conductivity and Ohm's law, Thermal conductivity, Momentum space, Fermi-Dirac distribution, Quantum theory of Free electron, escape of electron from a metal, Importance of Hall effect,

Nuclear Physics: Introduction to Nuclear Physics: nuclear constituents, nuclear properties, binding energy, Packing fraction, Nuclear force, fission and fusion process. Radioactivity; introduction to radioactivity, Laws of radioactivity disintegration. Half-life, Mean life, Laws of successive disintegration, Practical application of radioactivity.

Reference Book:

1. Neeraj, Mehta. Applied physics for engineers. PHI Learning Pvt. Ltd., 2011.Modern Nuclear Physics: From Fundamentals to Frontiers Edition by Alexandre Obertelli, Hiroyuki Sagawa

2. Lamarsh, John R., and Anthony John Baratta. Introduction to nuclear engineering. Vol. 3. Upper Saddle River, NJ: Prentice hall, 2001.

PHY 1102
Sessional on PHY 1101
(Credit: 0.75)

Experiments based on PHY 1101.

CHE 1101
Engineering Chemistry
(Credit: 3.00)

Chemistry of Polymer: Polymer and polymerization, co-polymerization, ionic polymerization, living polymer, structure and properties of macromolecules.

Plastics & Fibers: Fundamental characteristics, classification, raw materials and manufacture of plastics, some typical examples of plastics and their uses. Types of fibers, raw materials, application and manufacturing processes of synthetic fibers.

Rubber: sources of natural rubber, chemical treatment of latex, raw materials, synthetic reactions and properties of synthetic rubber.

Fertilizer, Paper, Sugar and Cement: Raw materials and manufacturing process.

Colloids: Introduction to Colloids, Classification of Colloidal Systems, Preparation of Colloids. Properties of Colloids, Dialysis, Electro dialysis, Ultrafiltration, Electrophoresis, Electro osmosis, Electrical Double Layer and Zeta potential. Micelles, Application of Colloids.

Chemical Corrosion: Introduction to Chemical corrosion, Direct chemical corrosion, Electrochemical corrosion, Factors affecting chemical corrosion, Galvanic corrosion, Atmospheric corrosion, Open air corrosion, Corrosion in contact with soil, and Prevention of corrosion.

Glass & Ceramic: Raw materials, Classification, Manufacturing processes, properties and applications

Reference Book:

1. McCafferty, Edward. Introduction to corrosion science. Springer Science & Business Media, 2010.
2. Ambasta, B. K. Chemistry for engineers. Laxmi Publications, 2008.

CHE 1102
Sessional on CHE 1101
(Credit: 0.75)

Volumetric analysis, Acid-base titration, Oxidation-reduction titration, Determination of Fe, Cu and Ca volumetrically. Gravimetric analysis: Determination of Sulphate and Iron.

EEE 1101
Electrical Circuits Analysis
(Credit: 3.00)

Basic Concepts of Electrical Circuits: Charge, Current, Voltage, Power, DC Voltage and DC Current Sources, Sinusoidal AC Voltage Characteristics and Definition, Phase Relation, Average Value, Effective (rms) Values, Different AC Waveforms- Square, Triangular, Rectangular and Sawtooth.

The Basic Electrical Circuit Elements: Response of Basic R, L, and C Elementsto DC and a Sinusoidal Voltage or Current, Admittance, Susceptance, Reactance and Impedance of R, L, and C Elements, Frequency Response of the Basic Elements, Average Power and Power Factor, Phasor.

Methods of Circuit Analysis (DC & AC): Ohm's Law, Nodes, Branches, Loops, Kirchhoff's Laws, Independent versus Dependent Sources, Source Conversions, Mesh Analysis, The Supermesh, Nodal Analysis, The Supernode, Delta-Wye Conversion.

Network Theorems (DC & AC): Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Millman's Theorem, Substitution Theorem, and Reciprocity Theorem.

RC, RL and RLC Circuits: Source Free and Unit Step Transient Responses of RC and RL Circuits, RC and RL High-Pass, Low-Pass Filters, Band-pass and Band-Stop Filters, Source Free and Unit Step Transient Responses in RLC Circuit different Damping Characteristics, Series and Parallel RLC Resonances.

AC Power and Polyphase Circuits: Instantaneous Power, Average Power, Effective Values of Current and Voltage, Apparent Power, Power Factor and Complex Power, Polyphase Systems, Single-Phase Three-Wire Systems, Three-Phase Y-Y Connection, The Delta Connection Power Measurement in Three-Phase Systems.

Reference Book:

1. Fundamentals of Electric Circuits, 5th Edition, Charles Alexander and Matthew Sadiku, McGraw-Hill Education.

2. Introductory Circuit Analysis, 13th Edition, Robert L. Boylestad, Pearson Education. 3. Engineering Circuit Analysis, 9th Edition, William H. Hayt and Jack Kemmerly, McGraw-Hill Education.

3. Electronics and Circuit Analysis Using MATLAB, 2nd Edition, John O. Attia, CRC Press.

EEE 1102
Sessional on EEE 1101
(Credit: 0.75)

Sessional based on the topics covered by EEE 1101.

MEC 1100
Engineering Drawing
(Credit: 1.50)

Introduction: Drawing instruments and accessories, lettering and dimensioning practices, Scales, Geometrical constructions Polygon, Hyperbola, Parabola, Ellipse, orthographic projections, projection of solids, development of surfaces, Intersection of surfaces

Projections: Fundamental principles and applications of Orthogonal projection, Visibility, Angle problem, Oblique projection, Isometric projection; Auxiliary projection, Orthographic and auxiliary projection from pictorial views, pictorial projection from orthographic views, Development of objects.

Descriptive Geometry: Projection, methods of transferring projection, practical application of descriptive geometry, Sectional views.

Reference Book:

1. Shah, Mahendrakumar Budhichand, and Bachubhai Chhibubhai Rana. Engineering Drawing. Pearson Education India, 2009.

2. Pal, Subrata, and Madhusudan Bhattacharyya. Engineering Drawing. Viva Books, 2005.

MES 1102
Workshop Practice
(Credit: 2.00)

Acquaintance with hand and machine tools used in wood working shop. Identification of timbers, Sawing, Planning and chiseling practices. Pattern making; Acquaintance with tools and appliances used in foundry; molding sand preparation, metal casting. Acquaintance with tools and machines used in welding shop. Arc and gas welding practice.

1st Year 2nd Term

MAT 1201
Mathematics - II
(Credit: 3.00)

Coordinate geometry of three dimensions: System of Coordinates. Distance between two points, section formula, projections, and direction cosines, Planes. Coordinate geometry of three dimensions, System of coordinates. Distance Straight lines, Sphere. Standard equations of Cone and central coincide.

Differential equations: Origin and formation of differential equations, Order and degree of differential equations. Solution of 1st-order 1st-degree differential equations by various methods, applications of 1st-order differential equations in geometry and physical problems. Solutions of higher order linear differential equations with constant coefficients by various methods (general method. method of variation of parameters, method of undetermined coefficients and short method). Cauchy-Euler form of differential equations. Application of higher order differential equations.

Reference Book:

1. Eisenhart, Luther Pfahler. Coordinate geometry. Courier Corporation, 2005.

2. Braun, Martin, and Martin Golubitsky. Differential equations and their applications. Vol. 2. New York: Springer-Verlag, 1983.

PHY 1201
Physics - II
(Credit: 3.00)

Laser: History of Laser, generation of coherent radiation, Time coherence, spatial coherence, Gas Laser, Ruby Laser, polarization inversion and stimulated emission, model of ruby Laser, YAG Laser, Raman Laser, Semiconductor Laser, Application of Laser.

Thermal Physics: Kinetic theory of gases, Kinetic calculation of pressure, temperature and energy, Ratio of specific heats, Mean free path, Equation of state. The Zeroth law and First law of thermodynamics and their applications, Isothermal, Adiabatic, Isochoric and Isobaric processes, Work done by expanding gases, Adiabatic gas equation, Reversible and irreversible processes, Second law of thermodynamics, The Carnot cycle, Entropy, Entropy of a perfect gas.

Electricity and Magnetism: The electric force and Coulomb's law, Gauss law and its applications, The electric field and potential due to continuous charge distribution, electric dipole and quadruple, The magnetic field and flux, Magnetic force on a current carrying conductor, Hall effect, Biot-Savart law and Amperes law and their applications, Faraday law,

Lenz law, self-induction and mutual induction, Magnetic properties of matter, Different types of magnetism, Three magnetic vectors, Permeability and Susceptibility, Hysteresis.

Optics: Les Equation, Optical instruments, Compound microscope and resolving power of microscope, Camera and photographic technics, Image resolution, Fiber optics

Magnetic Circuits: Ampere's circuital law, B-H curve, solution of magnetic circuits, hysteresis and eddy current losses, relays, applications of magnetic force, resonance.

Reference Book:

1. Blundell, Stephen J., and Katherine M. Blundell. Concepts in thermal physics. Oup Oxford, 2010.
2. Neeraj, Mehta. Applied physics for engineers. PHI Learning Pvt. Ltd., 2011.

PHY 1202

Sessional on PHY 1201

(Credit: 0.75)

Experiments based on optics, sound and the theory of PHY 1201.

HUM 1201

Bangladesh Studies

(Credit: 2.00)

Introduction to the course and its objectives: Introduction to the past and present scenario of Bangladesh.

History and Society of Bengal under British rule and Pakistan rule: The impact of British and Pakistan rules on the economy and education of the people. Language Movement of 1952, Events Leading to the Mass Upsurge of 1969, the War of Independence and the Emergence of Bangladesh in 1971. Study of Geography and Resources of Bangladesh: Location, Area, Boundary, Ecological Settings, River System, Climate, People and Resources of Bangladesh. Social Structure of Bangladesh.

Culture of Bangladesh: Language, Literature, Art and Culture of Bangladesh. Politics, Formation and role of major political parties in Bangladesh and Constitutional development of Bangladesh. Economy of Bangladesh. Achievements in different sectors (economy, culture, sports etc.) of Bangladesh. Socio-cultural problems and prospects of Bangladesh.

Reference Book:

1. Van Schendel, Willem. A history of Bangladesh. Cambridge University Press, 2020.
2. Rahman Syadur, “Historical Dictionary of Bangladesh” the scarecrow press 2010

EEE 1201

Electrical Machines and Semiconductor Devices

(Credit 3.00)

Transformers: Single phase and three phases; open and short-circuit tests. Electrical Machines:

DC machines: DC generator and motors; speed control and applications of DC motor.

AC Machines: Synchronous and asynchronous machines; speed control and applications; starting of motors.

Introduction to Semiconductor Devices: Diode, Zener Diodes, Transistors, BJT, Biasing, FET, Amplifiers and their Applications- Operational Amplifier & Differential Amplifier. Introduction to silicon-controlled rectifier and its application; oscilloscope logic circuits, A/D and D/A conversion.

Reference Book:

1) Vukosavic, Slobodan N. Electrical machines. Springer Science & Business Media, 2012.
2) Singh, Yaduvir. Semiconductor devices. IK International Pvt Ltd, 2013.

EEE 1202

Sessional on EEE 1201

(Credit 0.75)

Sessional based on the theory of EEE 1201

MEC 1201

Thermodynamics

(Credit: 3.00)

Introduction: Macroscopic and Microscopic points of view, Definition of Thermodynamic terms; Heat, Work and their path dependence.

Ideal Gas: Definition and suitability as thermodynamic fluid; Equation of state, various thermodynamic processes. Specific heat, Internal energy, Enthalpy.

Pure substances: Phase and phase diagram, critical parameters and their significance, triple point, properties of water and steam, construction of p-V, T- S and h-S diagram for water and steam, steam tables, Mollier chart.

Introduction to steam generation: Working principle of common and modern boilers, boiler mountings and accessories, equivalent evaporation and boiler efficiency.

Laws of Thermodynamics: Statement and their corollaries, criterion of reversibility and irreversibility, entropy, Gibbs function and Helmholtz function, Maxwell's relations.

Air Standard Cycles: Carnot cycle, Otto cycle, Diesel cycles, Dual cycle, Stirling cycle, **Ericsson** cycle, Joule cycle, Brayton cycle, and their applications, Representation of various cycles on p-V and T-s planes, Cycle efficiency; Air compressors and blowers.

Vapor Power Cycles: Carnot cycle, Rankine cycle, Reheat cycle, Regenerative cycle, Binary cycle; Introduction to combined cycle.

Fuels and Their Properties: Classification of fuels, Formation of coal and petroleum fuel, grading of coal, Calorific value of fuels and its measurement, Freezing point, Flash point, Boiling point, Viscosity of liquid fuels, Modern development of solid, liquid and gaseous fuels, Nuclear fuels.

Mixture of Gases and Vapors: Mixture of ideal gases, gravimetric and volumetric analysis, Dalton's law of partial pressure, volume and entropy of gaseous mixture; Isentropic process with gaseous mixtures, Specific humidity, relative humidity, dew point, dry and wet bulb temperatures, Adiabatic saturation, Construction of psychometric chart and its uses.

Reference Book:

1. Bejan, Adrian. Advanced engineering thermodynamics. John Wiley & Sons, 2016.
2. Fermi, Enrico. Thermodynamics. Courier Corporation, 2012.

MEC 1202
Sessional on MEC 1201
(Credit: 0.75)

Sessional based on the theory of MEC 1201.

CSE 1201
Introduction to Computer Programming
(Credit: 3.00)

Introduction to Computer: Components, input and output devices, central processing unit, memory.

Introduction to Logic & Digital Circuit: Logic Operations, Basic Gates, OR, AND, NOT, NAND, NOR, X-OR, X-NOR, Flip Flops, Shift resisters, Counter, Binary and BCD Codes, Comparators. Introductory outputs using C.

Data Types and Operator: Declaring variables of

Data Input/Output: Variation and formats of getting input and giving output

Debugging: Program debugging and testing.

Control Statements: Implementation of all types of control statement structures such as if, else-if, nested else-if, switch, goto, while, do-while, for, etc.

Arrays: single and multi-dimensional arrays and their applications: matrix manipulation, sorting of data,

String: finding vowels and consonants from a given string, detecting palindrome, counting words of a string, reversing each word of a sentence, using different functions of string.h library.

Functions: Doing some previous problems using the function, passing arguments by value and by reference.

Recursion: Find the Greatest Common Divisor, Fibonacci, Factorial, and Tower of Hanoi.

Program Structure: Use static and global variables.

Pointers: Dynamic memory allocation, arrays of pointers, passing pointers to a function,

Structures and Unions: Data processing using structures and union, linked lists.

File: Opening, closing, creating and processing data files. Introduction to low-level programming.

Introduction to Object-Oriented Programming: Objects, encapsulation, inheritance, polymorphism and interfaces.

Reference Book:

1. Oualline, Steve. Practical C programming. “O’Reilly Media, Inc.", 1997.
2. Ritchie, Dennis M., et al. "The C programming language." Bell Sys. Tech. J 57.6 (1978): 1991-2019.

CSE 1202

Sessional on CSE 1201

(Credit: 1.50)

Sessional based on the theory of CSE 1201.

2nd Year 1st Term

MAT 2101
Mathematics - III
(Credit: 3.00)

Vector Calculus: Differentiation and integration of vectors together with elementary applications, Gradient of a scalar function, Divergence and Curl of a vector function, Physical significance of gradient, divergence and curl. Line, surface and volume integrals, Divergence and Curl, Stoke's theorem, Green's theorem, Gauss's theorem and their applications, Curvilinear Co-ordinates.

Matrices: Different types of matrices. Elementary transformation Inverse of matrices by elementary transformation. Linear de Rank and dence and independence of vectors and matrices. Solutions of system of equations using matrix and consistency. Eigen value and Eigen vectors.

Complex Variables: Complex variables and functions of complex variables. Limit and continuity of a function. Analytic function and its properties, Singularities.

Reference Book:

1. Bernstein, Dennis. Scalar, vector, and matrix mathematics: theory, facts, and formulas-revised and expanded edition. Princeton university press, 2018.
2. Davis, Stanley M., and Paul R. Lawrence. "Matrix." Reading, Mass (1977).
3. Conway, John B. Functions of one complex variable II. Vol. 159. Springer Science & Business Media, 2012.

HUM 2101
Economics & Accounting
(Credit: 3.00)

Economics:

Definition of Economics, principle of economics.

Micro Economics: Theory of Demand and supply and their elasticity; price determination, nature of economic theory, applicability of economic theory to the problems of developing countries, marginal analysis, optimization, market; production, production function, types of productivity, Internal and external economics and diseconomies.

Macro Economics: Savings, investment, national income analysis, inflation, causes and analysis of project appraisal, NPV, IRR and their application, cost-benefit analysis. Monetary policy, Fiscal policy and trade policy with reference to Bangladesh; Planning in Bangladesh.

Accounting:

Introduction: images of Accounting. Users of Accounting Information, Generally Accepted Accounting principle (GAAP), relationship of Accounting with engineering education.

The recording process: Business transactions, steps in the recording process, accounting equation, account, rules of debit and credit, Journal, Ledger, trial balance and adjusting entries.

Preparation of financial statement: Single or multiple-step income statements, owner's equity statement, classified balance sheet, and cash flow statement.

Cost Accounting: Concept of cost, classification of cost, statement of cost, material cost, labor cost, wages and salaries, operating and service costing.

Reference Book:

1. Lipsey, Richard, and Alec Chrystal. Economics. Oxford University Press, USA, 2011.
2. Godfrey, Jayne, et al. Accounting. John Wiley & Sons, Inc, 2010.

MEC 2103

Engineering Mechanics - I

(Credit: 3.00)

Introduction: Fundamental concept and principles of mechanics, Resultant of several concurrent forces, Resolution of forces into components.

Equilibrium of Particle: Free body diagram (Conditions of equilibrium in space, components of force in space, resultant of three-dimensional force systems, equilibrium in space for concurrent and non-concurrent and parallel force systems), Principle of transmissibility of forces and force couple system, Moment of a couple, equivalent couple, equivalent system of force and force couple systems, reduction of a system of forces.

Centroids and Center of Gravity of area and volume: Moment of inertia of area and mass, radius of gyration, parallel axes theorem, product of inertia, ellipsoid of inertia, parallel and angular shift of an axis and transfer formula.

Analysis of structure, trusses and frames

Law of Friction: Equilibrium under frictional resistance, sliding friction; wedges and square threaded screw, Journal and thrust friction, rolling and belt frictions.

Methods of Virtual Works: Application of the principle of virtual work, mechanical efficiency; potential energy and equilibrium, stability of equilibrium.

Reference Book:

1. Beer, Ferdinand Pierre, et al. Vector mechanics for engineers. Vol. 4. New York: McGraw-Hill, 1977.
2. Hand, Louis N., and Janet D. Finch. Analytical mechanics. Cambridge University Press, 1998.

MEC 2104
Sessional on MEC 2103
(Credit: 0.75)

Experiments based on the theory of MEC 2103

MEC 2105
Engineering Metallurgy
(Credit: 3.00)

Metals and Alloys: Industrially significant properties of metals, malleability, ductility, hardness, toughness, fatigue resistance, Destructive and non-destructive tests applicable to metals.

Crystal Structure of Metals: Types of crystal lattice, solidification of metals and alloys, nucleation, grain growth, variables affecting solidification, Equilibrium diagram for binary alloys, interpretation of equilibrium diagram, Structure and properties of metals and alloys related to equilibrium, Iron-Iron carbide equilibrium diagram.

Heat Treatment: Methods and effects of hardening, annealing, normalizing, quenching, tempering, case hardening processes, precipitation processes, nitriding, edge hardening. TTT diagram, S-curve.

Production, Properties and Uses: Ferrous materials, pig iron, wrought iron, cast iron, Types of cast iron, their properties and microstructures, effects of impurities on cast iron, Production of steels, their types, Bessemer and open-hearth processes, Alloy steels, Stainless steels, carbon steels.

Production Methods: Properties and uses of copper, aluminum, nickel, tin and lead, Alloys of noble metals, bearing materials, spring materials.

Metallurgical Aspect of Metal Joining: Surface treatments, plating, metal coating, metal spraying.

Powder Metallurgy: Metal Powder characteristics, welding of powders, sintering, pressing.

Reference Book:

1. Higgins, Raymond A. Engineering metallurgy. LONDON• SYDNEY• AUCKLAND, 1993.
2. Smallman, Raymond Edward, and Ray J. Bishop. Modern physical metallurgy and materials engineering. Butterworth-Heinemann, 1999
3.

MEC 2106
Sessional on MEC 2105
(Credit: 0.75)

Experiments based on the theory of MEC 2105.

MEC 2107

Statistics & Quality Control

(Credit: 3.00)

Statistics

Introduction to data analysis: Basic Concepts about data, Events, Variables, probability, Population and Samples;

Data presentation formats: Grouped data, ungrouped data, and Frequency distribution: relative and cumulative.

Properties of data: Average, Median, Mode, Standard deviation, Moment, Skewness, Peakedness and Coefficient of variation.

Probability: Basic concepts, Fundamentals of sets, Venn diagrams and set operations, Axioms of probability, Probability rules, Conditional probability and Independent events, Bayes formula. Statistical distributions and their uses: Introduction to probability density functions and their physical significance, Hypergeometric, Geometric, Binomial, Poisson, Normal, Uniform, Exponential, Yand t-distributions.

Introduction to statistical inference: - Rationale of hypothesis testing. Types of errors, One-sided test, Two-sided test, Operation characteristic curves, Statistical inference for goodness of fit.

Quality Control:

Statistical process control: Introduction: Basic concepts of quality and quality costs.

Philosophy of Statistical Process Control: Chance and assignable causes of quality variation;

Methods of Statistical Process control: Pareto analysis, cause and effect diagram, Histogram, control charts.

Statistical basis of the control chart: Basic principles, Choice of control limits; Sample size and sampling frequency, Rational subgroups, Analysis of Patterns on Control Charts;

Control charts for attributes: The control chart for fraction nonconforming: Development and operation of the control chart; Variable sample size, Non- manufacturing applications, the operating characteristic function and average run length calculations. Control charts for nonconformities (defects), Procedures with constant sample size, Procedures with variable sample size, Demerit systems, the operating characteristic function; Dealing with low-defect levels,

Control charts for variables: Control charts for, X, R and o; Statistical Basis of the Charts, Development and Use of X and R charts, Charts Based on Standard Values, Interpretation of X and R Charts, The operating-characteristic function, The average run length for the and R charts, The effect of non-normality on X and R charts.

Process-capability analysis: Process-capability analysis using histogram and control chart.

TQM: Concept, QC circle, TQC, Impact on industries, ISO series.

Reference Book:

1. Ishikawa, Kaoru, and John Howard Loftus. Introduction to quality control. Vol. 98. Tokyo: 3A Corporation, 1990.
2. Papoulis, Athanasios. Probability and statistics. Prentice-Hall, Inc., 1990.

MEC 2100
CAD/CAM
(Credit: 1.50)

Working drawing of machine elements using AutoCAD & Solid Works

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2nd Year 2nd Term

MAT 2201
Mathematics - IV
(Credit: 3.00)

Fourier series: Existence of Fourier series, Fourier series with different periods, half range series, Fourier Transformation.

Special functions: Bessel's functions and Legendre polynomials. Orthogonality, generating function and recurrence relations of them.

Partial Differential Equations (PDE): Formation and Classification of PDEs. Solution of one-dimensional heat and wave equations. Solution of Laplace's equation in 2-dimensional Cartesian and polar coordinates with their application in heat distribution. Solution of Laplace's equation in spherical and cylindrical polar coordinates.

Laplace Transforms: Definition and existence condition of Laplace transform. Properties of Laplace transform. Transform of elementary functions. Inverse Laplace transform and its properties. Convolution. Solution of ordinary and partial differential equations using Laplace transform. Definition of Laplace transforms; Elementary transformation and its properties; Convolution; Solution of differential equations by Laplace transforms.

Reference Book:

1. Tolstov, Georgi P. Fourier series. Courier Corporation, 2012.
2. Yakubov, Yakov, and Sasun Yakubov. Differential-operator equations: ordinary and partial differential equations. Vol. 103. CRC Press, 1999.

HUM 2201
Industrial Environment and Sociology
(Credit: 3.00)

Industrial Environment:

Population and economic growth, industrialization, urbanization and energy use, Causes of environmental pollution, Mass and energy balance for environmental engineering systems under steady state and unsteady state conditions,

Definition and characteristics of industrial and hazardous wastes: Their generation rates and prevention, Introduction to I&H waste collection, transportation, treatment, monitoring, disposal and environmental impact. Applicable international and national regulations and initiatives.

Introduction industrial law: Inspectors and certifying Surgeons, Health and hygiene, Safety, Welfare, working hours of Adults, Employment of young persons, Leave and Holidays with wages, Penalties and Implementation procedure, Payment of wages Act, Shops and Establishment Act. Bangladesh Labour Act, 2006, EPZ Workers Association and

Industrial Relations Act, 2004, Bangladesh Environment Conservation Act, 1995 and Rules, 1997, International Labour Organization (ILO);

Sociology:

Introduction to Sociology and its impact on engineering, fundamental concept of society, community, association, group, mob, Social history and culture of Bangladesh

Urbanization and industrialization in Bangladesh and their effects, urban ecology, social problem, population, poverty, beggary, immoral income, crime and juvenile delinquency.

Reference Book:

1. Saxena, Gaurav, R. Kishor, and R. N. Bharagava. Bioremediation of industrial waste for environmental safety. Singapore: Springer Singapore, 2020.
2. Fulcher, James, and John Scott. Sociology. Oxford University Press, USA, 2011.

MEC 2203

Engineering Mechanics - II

(Credit: 3.00)

Kinematics of particles: Rectilinear and curvilinear motion of particles, Determination of the motion of a particle, motion of several particles, rectangular components of velocity and acceleration, Motion relative to frame in translation, tangential, normal, radial and transverse components.

Kinematics of rigid bodies: Translation, Rotation about a fixed axis, General plane motion, motion about a fixed point and general motion, Absolute velocity and acceleration, relative velocity and acceleration, Coriolis acceleration.

Kinetics of particles: Newton's second law of motion, linear and angular momentum, radial and transverse components of motion, motion under a central force, two body problem, satellite motion, equation of orbit, conditions of orbiting and escape, cycle time, changing of orbit.

Work and energy: Principle of work and energy and its efficiency, Potential energy, conservative forces, Conse application to space mechanics; Principle of impulse and oblique central impact.

Kinetics of rigid bodies: Plane motion of rigid bodies; Equation of motion, angular momentum and D'alembert principle, constrained plane motion; Work of forces acting on a rigid body, Kinetic energy of rigid body in plane motion; Principle of work and energy for the plane motion of rigid body, principle of impulse and momentum for the plane motion of a rigid body, Concentric impact.

Kinetics of rigid bodies in three dimensions: Introduction, Angular momentum, Kinetic energy and motion of a rigid body in three dimensions, Euler's equations of motion and their application in general motion, Eulerian angles and motion about a point fixed in space, Steady precision of gyroscope, motion of an axisymmetric body under no force, Gyroscopic couple, effect of the gyroscopic couple on an airplane, a naval ship during steering, pitching and rolling, Gyroscopic stabilization.

Reference Book:

1. Beer, Ferdinand Pierre, et al. Vector mechanics for engineers. Vol. 4. New York: McGraw-Hill, 1977.
2. Hand, Louis N., and Janet D. Finch. Analytical mechanics. Cambridge University Press, 1998.

MEC 2204
Sessional on MEC 2203
(Credit: 0.75)

Experiments Based on the theory of MEC 2103.

MEC 2209
Mechanics of Solid
(Credit: 3.00)

Stress and Strain: Introduction, Analysis of internal forces; Tensile, compressive, bearing and shearing stresses, Stresses in thin-walled pressure cylinder, Stress-strain diagram, Axial, biaxial and tri-axial deformations, Statically indeterminate members, Thermal stresses.

Statically Determinate Beams: Introduction, Different types of loading and supports, Shear force and bending moment diagrams, Stresses in beams, flexure formula, economic sections, shearing stresses in beams, general shear formula; variation of shearing stresses in beams, Deflection of beams, double integration, area-moment and superposition methods, Reinforced beams, design of reinforced concrete beams.

Statically Indeterminate Beams: Introduction, Propped and restrained beams, Design of restrained beams, Continuous beams, Derivation of the three-moment equation and its applications, Determination of support reactions of con beams.

Torsion: Introduction, Torsion formula, Angle of twist, Shaft couplings and helical springs, Analysis and design of circular shaft.

Combined Stresses: Introduction, Combined axial and bending stresses, Kern of section, Stress at a point, Analytical method for the determination of stresses on oblique sections, Mohr's circle and its application to combined loadings, Transformation of strain components, Strain rosette.

Columns: Introduction, Critical load, slenderness ratio and classification of columns, Euler's formula, empirical formulas and secant formula.

Riveted and Welded Connections: Introduction, Stresses in riveted joints; eccentrically loaded riveted and welded connections.

Reference Book:

1. Pytel, A., Singer, F. L. (1987). Strength of Materials. United Kingdom: Harper & Row.
2. Den Hartog, Jacob Pieter. Strength of materials. Courier Corporation, 2012.

MEC 2210
Sessional on MEC 2209
(Credit: 0.75)

Sessional based on MEC 2209

MEC 2211
Measurement and Industrial Instrumentation
(Credit: 3.00)

Instrumentation: Classification of measuring instrument, characteristics of instrument, sensitivity and resolution of instrument, measurement system errors, electromechanical and electronic meters and their uses.

Sensors: pressure sensor, temperature sensor, optical sensor, flow sensor, strain gauge sensor, ultrasonic sensor and speed sensor; analogue and digital signal processing, data acquisition and processing techniques, Data logging and Display, errors and significant digits. Statistical analysis and data improvement. Calibration. Review of basic electricity

Principles and applications: Principles and applications of measuring instruments and sensors in mechanical engineering such as measurements of distance, linear and angular velocity, acceleration and vibration; measurements of temperature, humidity, energy and heat transfer; measurements of force, torque, stress and strain; measurement of viscosity, flow velocity, flow rate and pressure; etc. High-temperature measurement and control.

Reference Book:

1. Dunn, William C. Fundamentals of industrial instrumentation and process control. McGraw-Hill Education, 2018.
2. Meyer, J. Patrick. Applied measurement with jMetrik. Routledge, 2014.

MEC 2212
Sessional on MEC 2211
(Credit: 0.75)

Experiments based on data acquisition, data analysis, PLC and sensors.

MEC 2200
Simulation & Modeling
(Credit: 1.50)

Solution of Mechanical Engineering Problems Using Standard Simulation Software

3rd Year 1st Term

MEC 3101
Heat and Mass Transfer
(Credit: 3.00)

Basic modes of heat transfer: General conduction equation; Steady state conduction in different geometries and composite structures; Thermal contact resistance; Unsteady heat conduction in solids; Laws of radiation heat transfer; Radiation shape factor; Radiation interchange between two surfaces; Gas radiation; Heat and momentum transfer associated with laminar and turbulent flows of fluids in forced convection; Velocity and thermal boundary layer developments in tubes (ducts) and over flat plate; Natural convection heat transfer; Heat transfer mechanism with change of phase;

Boiling and condensation: mechanism and heat transfer correlations; Mechanism of mass transfer by diffusion, convection and change of phase; Analogy between heat and mass transfer.

Reference Book:

1. Holman, Jack Philip. Heat transfer. McGraw Hill, 1986.
2. Janna, William S. Engineering heat transfer. CRC press, 2018.

MEC 3102
Sessional on MEC 3101
(Credit: 0.75)

Experiments Based on the theory of MEC 3101.

MEC 3103
Theory of Machine
(Credit: 3.00)

Introduction to theory of machines.

Mechanics of Machinery: Inertia and kinetic energy of rotation and reciprocating parts; Turning moment diagram, fluctuation of energy and speed; Fly wheel; Balancing of stationary, rotating and reciprocating masses, balancing of in-line engines and v- engines, principle of direct and reverse cranks in balancing problems. Balancing machines; Law of gearing forms of tooth and types of gear, Gear trains and their arrangements; Types of governor's control, Cam and follower, various profiles of cams and their motions.

Vibration: Free, forced and damped vibration of systems having one freedom: Beat, resonance and transient phenomena in forced Torsional oscillation of shafts, whirling of shafts, transverse vibration simple pendulum treated by energy method; Simple situation of

vibration two degree of freedom having elastic constraints; Torsional oscillation o. Shafts with multi rotors; Self-excited vibration; vibration measurement and measuring instruments, elastic suspension of machinery for isolation of vibration; Vibration absorber.

Reference Book:

1. Khurmi, R. S., and J. K. Gupta. *Theory of machines*. S. Chand Publishing, 2005.
2. Reuleaux, Franz. The kinematics of machinery: outlines of a theory of machines. Courier Corporation, 2013.

MEC 3104
Sessional on MEC 3103
(Credit: 0.75)

Experiments based on the theory of MEC 3103.

MEC 3113
Machine Tools & Tool Engineering
(Credit: 3.00)

Tool Engineering

Work holding devices: Degrees of freedoms, Basic principles of locations; locating methods and devices; Types of locator and their applications; Basic principle of clamping; Clamping devices and forces; Types of clamps.

Design and detail study of Jigs and fixtures: Types of drill jigs; Lathe, milling, boring, broaching and grinding fixtures.

Die design: Dies and punches; Introduction to die cutting operations; Cutting operation by punch; Die clearance; Blanking and piercing die design; strip layout; Bending, Forming and drawing dies; Drawing forces and blank size determination.

Machine Tools: Lathe machine and its accessories; Turret and others special purpose lathes; Drilling machine and other hole making processes; Shapers and Planers; Milling machine and various milling operations; Manufacturing processes of Screw threads, Gears and related machine. General purpose and special purpose of machine tools; recent developments in machine tools; Maintenance of machine tools.

Study and Operation Procedures: Power requirements, drive and power transmission mechanism of commonly used machine tools: Lathe, Drilling Machines; ray diagram and saw diagram; speed structure diagrams.

Numerical Control of Machine Tools: Concept of CAM, CNC and DNC machines.

Machine Tools Structures: Study of beds, columns

Reference Book:

1. Nagpal, G. R. "A textbook on machine tool engineering." Khanna Publishers, Brahmpuri, Delhi 10053 (2004): 243-266.
2. Smith, Graham T. Cutting tool technology: industrial handbook. London: Springer, 2008.

MEC 3114
Sessional on MEC 3113
(Credit: 0.75)

Experiments based on the theory of MEC 3113.

MEC 3115
Fluid Mechanics I
(Credit: 3.00)

Introduction: Fundamental concept and fluid as a continuum; Classification of fluids. Viscosity and its measurement; Stress and strain of fluids; Compressibility and elasticity; Surface tension and capillarity; Vapor pressure.

Fluid Static: Pressure at a point, pressure gradient; Manometers; Pressure on plane and curved surfaces immersed in fluids; Buoyancy and floatation, metacenter and metacentric height, stability of submerged and floating bodies; Fluid containers subjected to constant acceleration and rotation.

Fluid Dynamics: Velocity and acceleration of fluid particles, types of fluid flow, relation between system approach and control volume approach; Continuity equation in integral and differential form; Euler's equation, Bernoulli's equation, Energy equation and their applications; Energy grade line and Hydraulic grade line.

Viscous flow: Viscous flow in pipes, laws of fluid friction; Darcy - Weisbech equation: Pressure gradient and shear stress in laminar flow, Hagen-Poisuille law, and laminar flow through inclined pipes, annulus pipes and parallel plates; Moody chart for friction and its application.

Measurement of Fluid Flow: Measurement of fluid velocity by Pitot tube and Anemometer; Measurement of fluid flow by Venturimeter, rotameter, notches and weirs, flow through orifices and mouth pieces; Time required to emptying a tank due to flow through orifice at the bottom and at the side of the tank, flow between connected vessels.

Reference Book:

1. Munson, Bruce Roy, et al. Fluid mechanics. Singapore: Wiley, 2013.
2. White, Frank M. Fluid mechanics. New York, 1990.

MEC 3116
Sessional on MEC 3115
(Credit: 0.75)

Experiments based on the theory of MEC 3115

MEC 3117

Numerical Computation for Mechanical Engineers

(Credit: 3.00)

Interpolation: Newton's formulae for forward and backward interpolation, Lagrange's interpolation method, Stirling's interpolation method and Bessel's interpolation method.

Solution of nonlinear algebraic equation: Iterative method, Regula falsi method, Newton-Raphson method; Graphical presentation and significance of the above methods; Initial approximation and convergence criteria, Checking for convergence.

Solution of linear algebraic equation: Iterative method, Matrix inversion method, Gauss elimination and pivoting method, Triangular factorization method.

Numerical differentiation: Expansion of a function by Taylor's series; Forward difference formula, Central difference formula and backward difference formula, their error calculation and application. Graphical method of differentiation; Partial differentiation.

Numerical Integration: General formula for equidistant ordinates, Trapezoidal rule, Simpson's rule, Weddle's rule and calculation of their error; Graphical integration.

Solution of differential equations: Introduction to differential equation, geometric interpretation; Euler's method, Taylor series method, Rnuge-Kutta method of different order, Predictor-Corrector methods, their application and error analysis.

Solution of partial differential equations (PDE): Introduction to differential equation, geometric interpretation; Definition of Elliptic, Parabolic and Hyperbolic PDE and their solution by finite difference technique, D'Alemdert's solution, Crank-Nicholson method, Iterative method. Calculation of residuals and test of accuracy.

Curve fitting: Linear regression and correlation, Least squares estimators, confidence limits and test of significance.

Eigen values and Eigen vectors: Introduction and concept of Eigen value and Eigen vector. Solution of homogeneous linear system, estimation of the size of Eigen values.

Reference Book:

1. Burden, Richard L. Numerical analysis. Brooks/Cole Cengage Learning, 2011.
2. Gautschi, Walter. Numerical analysis. Springer Science & Business Media, 2011.

MEC 3118

Sessional on MEC 3117

(Credit: 0.75)

Computer applications on the problems based on the theory of MEC 3117.

3rd Year 2nd Term

MEC 3201
Heat Transfer Equipment Design
(Credit: 3.00)

Concept of thermal system design: Heat transfer requirements, Mechanical design, Design parameters, Materials, cost and economics, Safety and reliability, Choice and availability, Optimization, Cyclic service.

Heat transfer from finned surface: Basic fin design, Types of fins, Fin Performance, Efficiency of fins, Equation of heat transfer from fins, Analysis of unsteady heat conduction.

Basic thermal design methods of heat exchangers: Types of heat exchangers; Parallel flow, counter flow, cross flow, shell-and-tube, mixed and unmixed, single and multiple pass, compact heat exchangers, Thermo-fluid characteristics, Sizing of heat exchangers, Fouling of heat exchangers, Performance of heat transfer equipment, the log mean temperature difference, Effectiveness-NTU method, F correction factor.

Two-phase heat transfer equipment: Boiler, Evaporator, Condenser, Cooling tower.

Thermal systems with internal heat source: Modelling of thermal equipment.

Reference Book:

1. Holman, Jack Philip. Heat transfer. McGraw Hill, 1986.
2. Janna, William S. Engineering heat transfer. CRC press, 2018.

MEC 3202
Sessional on MEC 3201
(Credit: 0.75)

Experiments based on the theory of MEC 3201.

MEC 3215
Fluid Mechanics - II
(Credit: 3.00)

Dimensional Analysis and Similitude: Fundamental and derived units, dimensional homogeneity, Buckingham's л-theorem, dimensional analysis in various practical engineering fluid flow problems, Application of Significance of dimensionless numbers related to fluid mechanics and similitude.

Flow over submerged body: Internal flow and external flow, Introduction to turbulent flow, Prandtl Law, effect of surface roughness on internal and external flow over submerged body.

Boundary layer theory: Concept of boundary layer, boundary layer thickness, boundary layer growth and characteristics of boundary layer

Boundary layer equation and its application: Von-Karman integral m Boundary layer over a flat plate and without zero pressure and its control, friction drag, displacement and momentum theory, boundary layer, effect of pressure gradient on boundary layer, Transition for flat plate flow. Effect of surface roughness on boundary layer.

Compressible flow: Steady one dimensional flow, Continuity, momentum and energy equations, Mach cone, stagnation properties, Isentropic flow through nozzles. Adiabatic and Diabetic flow through pipes with friction and without friction, Shock waves, Fanno line and Rayleigh line.

Ideal fluid flow: Rotational and irrotational flows, Velocity potential and stream function, Free and forced vortex motions, Doublet, Cauchy-Rieman equation, Flow net, Combination of rectilinear flow with source and sink, Circulation and Vorticity, Flow around a cylinder with and without circulation, Magnus effect and aerodynamic lift.

Reference Book:

1. Giles, Ranald V., Jack B. Evett, and Cheng Liu. Schaum's outline of fluid mechanics and hydraulics. McGraw-Hill Education, 2014.
2. Bansal, R. K. A textbook of fluid mechanics. Firewall Media, 2005.

MEC 3216
Sessional on MEC 3215
(Credit: 0.75)

Experiments based on the theory of MEC 3215

MEC 3219
Manufacturing Process
(Credit: 3.00)

Introduction to Manufacturing Processes: Introduction, manufacturing system, types of production, control system, organization, administration and management, plant organization, scientific management, functions of management, plant location, plant layout, production planning and control (PPC), basic concept of drilling, milling, shaper machine etc.

Casting: Methods of Sand Casting, Design of patterns, Properties of molding sand, Sand testing, Core making, die casting, Centrifugal and Allied castings, Precision investment casting, Continuous casting, casting defects.

Welding and Allied Process: Gas welding, Electric Arc welding, Shield Arc welding, Resistance welding, Pressure welding, Thermite welding, Energy ray welding, Welding defects, Soldering, Brazing and Braze welding, Metal spraying, Hard facing.

Metal Forming Processes: Various hot and cold working processes, Description of related machine and tools.

Metal Cutting Processes: Mechanism of chip formation, Types of chip, Chip breaker, Cutting forces. Cutting fluid

Finishing Operations: Grinding, Surface grinding, Center less grinding, Honing, Lapping, Super finishing.

Introduction to Modern Manufacturing Processes: ECM, EDM, USM, LBM, PAM etc.

Reference Book:

1. Jain, R.K. (2009) Production Technology. 16th Edition, Khana Publishers, Delhi, 153-158.
2. Klocke, Fritz, and Aaron Kuchle. Manufacturing processes. Vol. 2. Berlin: Springer, 2009.

MEC 3220

Sessional on MEC 3219

(Credit: 0.75)

Practice of different operations on Lathe machine, drilling machine, milling machine, Shaper machine, grinding machine etc. and Experiments based on the theory of MEC 3207.

MEC 3221

Machine Design -I

(Credit: 3.00)

Stress, Allowance & Tolerance: Approach to design, Stress analysis, Tolerances and allowances, Variable loads and stress concentrations, Screw fastening and rivet joints,

Spring & Column: Design of various types of springs, column design for central and eccentric loads.

Combined Stress: Combined stresses, shaft design, Design of keys and couplings, Design for combined stresses.

Reference Book:

1. Faires, Virgil Moring, and Roy M. Wingren. "Problems on the design of machine elements." (No Title) (1965).
2. Khurmi, R. S., and J. K. Gupta. A textbook of machine design. S. Chand publishing, 2005.

MEC 3222
Sessional on MEC 3221
(Credit: 0.75)

To solve the design problems based on the theory of MEC 3221

MEC 3223
Operations Management
(Credit: 3.00)

Overview of operations management: Some basic concepts, Management process, Basic purpose, Objectives, Targets, Production process, Production or Operations System, Types of production or operations systems, The role of operations management, Functions of operations management;

Economic analysis: Cost classification, Break-even analysis, Adjustments for the time value of money, Methods for evaluating capital investments.

Process design: Introduction, Types of production processes, Methodology for process design, Graphic aids for process design, Process design and energy considerations, Process design and environmental pollution recycling.

Work analysis, design, and measurement: Work analysis, people or machines, a comparative evaluation; Work-content determination, Work- methods design; work measurement, the effect of learning on standard times; learning curves.

Layout and safety: Dependence of Layout on production flow; Product (or Line) Layout, Process layout, Fixed-Position layout, Group layout, Safety considerations and OSHA, layout design.

Facility location: Introduction, the location problem, Approach to plant location; The Brown-Gibson approach for site selection.

Demand forecasting: system and methods, Importance of demand forecasts, The demand forecasting system, Forecasting methods, Subjective (or Predictive) forecasting methods, Causal forecasting methods, Time series forecasting methods, Routine short-term forecasting,

Inventory systems and models: Specification of an inventory system, Determination of inventory related costs, Inventory model building, Economic- order-quantity (EOQ) model, Economic-production-quantity (EPQ) model, Inventory model allowing shortages, Inventory model allowing price discounts, A single-stage inventory model under conditions of risk.

Inventory-management systems: Determination of safety-stock size for specified service level; the fixed-order-quantity (Continuous-review), The Fixed-order-interval (Periodic-review) system, the base-stock (Optional Replenishment) System, Material-Requirements Planning (MRP)

JIT: Concept, JIT flow, implication.

Operations scheduling: Introduction, the scheduling system, Flow-shop scheduling, Job-shop scheduling, Project Scheduling with CPM and PERT.

Reference Book:

1. Kumar, S. Anil, and N. Suresh. Production and operations management. New Age International, 2006.
2. Iravani, Seyed MR. Operations Engineering and Management: Concepts, Analytics, and Principles for Improvement. McGraw-Hill Education, 2021.

MEC 3225
Research Methodology & Scientific Research
(Credit: 3.00)

Introduction: Definition of Scientific Research and Scientific Work, Research methodology, Research method, History of research, Types of research (Pure, Applied, Fundamental, Social Science research), Research characteristics, Problem statement, Research question, Research gap, Research objectives, Topic Selection, How to Select Methods according to the Research Topic.

Writing Procedures: How to Write a Literature Review, How to Write a Framework of Dissertation, Scientific Report, Project Report and Journal Paper, Writing Results and Discussion. Criticizing and decision making, Scientific Presentation Techniques. Writing Conclusions, Suggestions, and Appendix.

Data Analysis: What is primary and secondary data? Data collection method, Analysis of data (quantitative and qualitative), Tools for data analysis, modeling, development of co-relation, Uncertainty of data, Hypothesis generation, Hypothesis validation.

Research Ethic: Research Misconduct, Conflict of Interest, Plagiarism, Avoid of Plagiarism, Punishment of Plagiarism.

Referencing: Referencing Styles, Reference Management.

Reference Book:

1. Thomas, C. G. (2021). Research methodology and scientific writing. Thrissur: Springer.
2. Säfsten, K., & Gustavsson, M. (2020). Research methodology: for engineers and other problem-solvers.

MEC 3200
Integrated Project Design
(Credit: 2.00)

Design & development of a Mechanical Element (group project)

4th Year 1st Term

MEC 4101
Internal Combustion Engine
(Credit: 3.00)

Gas turbines: Open and closed cycle gas turbines and their performances, Modifications of simple gas turbines cycle, reheat, regenerative, inter-cooling etc. Jet propulsion and rocket propulsion; propellants and their criteria, Air-Fuel Ratio, Specific Fuel Consumption. Efficiency of propulsive units; Boosting.

Turbo-machinery: Steam turbines, Impulse and reaction type, convergent and divergent nozzles theory and design of nozzles, Stage efficiency, degree of reaction. Performance of steam turbines. Compounding of turbines, optimum velocity ratio, reheat factor and condition line, loses in steam turbines, steam turbine governing. Steam Condensers.

Combustion and oxidation: Complete and incomplete combustion, Stoichiometric AFR, Heat of reaction, chemically correct mixture and AFR, chemistry of combustion.

Internal combustion engines: Classification of engines, Engine testing, types of tests, measurement of torque, speed, fuel and air consumption etc., Heat balance, Performance factors, indicator diagram, Indicated power, brake power, mep, specific fuel consumption, thermal, mechanical and volumetric efficiencies; performance curves, factors limiting performance of IC engines, Fuel metering of SI and CI engines; reaction rate and flame propagation, auto ignition and chemical reaction, knocking and detonation in SI and CI engines, fuel additives, Combustion chamber design of SI and CI engines, Scavenging and Supercharging;

Reference Book:

1. Heywood, John B. Internal combustion engine fundamentals. McGraw-Hill Education, 2018.
2. Srivastava, Dhananjay Kumar, et al., eds. Advances in internal combustion engine research. Springer Singapore, 2018.

MEC 4102
Sessional on MEC 4101
(Credit: 0.75)

Experiments based on the theory of MEC 4101.

MEC 4115
Fluid Machinery
(Credit: 3.00)

Reciprocating pump: Definition and classification, work done, slip, effect of acceleration of piston and frictional losses on velocity and pressure during suction and delivery strokes, indicator diagram, air vessels. Cavitation and efficiency.

Centrifugal pump: Definition and classification, advantages and disadvantages of centrifugal pump over reciprocating pump, work done, efficiency, characteristic curves, minimum starting speed, least diameter of impeller, cavitation, priming, limitation of suction lift and specific speed of centrifugal pump.

Water turbine: Definition and classification. Impulse and Reaction turbines, Euler's turbine equation. Efficiency of Impulse and Reaction turbines, specific speed. Governing of turbine, Selection and model test of turbines, Cavitation of turbines.

Blower and Compressor: Introduction, classification and applications.

Impact of jets: Concept of momentum principle and derivation of momentum equations, Impact of jet on fixed and translating plane and curved vanes. Application of momentum equation to duct flow with and without change in direction, momentum and energy correction factor for laminar flow through pipes.

Open channel flow: Chezy, Gangulle-Kutter, Bazin and Manning's Formulae, Economic cross-section, specific energy and critical depth, Froud number and its significance in open channel flow, Hydraulic jump.

Reference Book:

1. Khurmi, R. S., and N. Khurmi. Hydraulics, Fluid Mechanics and Hydraulic Machines. S. Chand Publishing, 1987.
2. Shaughnessy, Edward J. Introduction to fluid mechanics. 2005.

MEC 4116
Sessional on MEC 4115
(Credit: 0.75)

Experiments based on the theory of MEC 4115.

MEC 4121
Machine Design -II
(Credit: 3.00)

Bearing: Design and selection of bearings; Journal and plane surface bearings; Ball and roller bearings.

Gears: Design of spur, helical, bevel and worm gears. Design of clutches and brakes; Design and selection of flexible power transmission elements;

Belt, Rope & Chain: Design of Belts, ropes and chains, Design of welded joints.

Reference Book:

1. Faires, Virgil Moring, and Roy M. Wingren. "Problems on the design of machine elements." (No Title) (1965).
2. Khurmi, R. S., and J. K. Gupta. A textbook of machine design. S. Chand publishing, 2005.

MEC 4122
Sessional on MEC 4121
(Credit: 0.75)

Design, detailed drawing using application software, construction a machine element and presentation at the end of the term.

MEC 4127
Refrigeration and Air-conditioning
(Credit: 3.00)

Refrigeration

Review of basic concepts and definitions of refrigeration system, application of refrigeration, Vapor compression refrigeration, Analysis of Vapor compression refrigeration cycle, Multi pressure systems of refrigeration, Absorption refrigeration, air cycle refrigeration, steam jet refrigeration, Vortex tube refrigeration,

Low Temperature Refrigeration: Cascade system, Liquidification of gases, Linde-Hampson and Claude system.

Refrigerants: Properties and numerical classifications of commonly used refrigerants.

Description and Operations of Various types of compressors, evaporators, condensers, and expansion devices used in commercial refrigeration systems and its maintenance.

Air-conditioning

Study of Fundamental Air-conditioning: Application of air-conditioning system, Ventilation systems, Psychometric processes, Psychometry and comfort data with application to air conditioning problem. Cooling load calculation, requirement for special deign buildings, Modifications of existing buildings.

Central and Unit system of Air-conditioning: Duct designing, fans and control system, Air filter, Air distribution/Air handling, Air-conditioning systems, and Air-conditioning equipment.

Air Handling Units, Calculation of Dehumidified Air Quantity.

Reference Book:

1. Khurmi, R. S., and J. K. Gupta. Textbook of refrigeration and air conditioning. S. Chand Publishing, 2008.

2. Althouse, Andrew Daniel, Carl Harold Turnquist, and Alfred F. Bracciano. "Modern refrigeration and air conditioning." (No Title) (2004).

MEC 40XX
Optional – I
(Credit: 3.00)

MEC 40XX
Optional – II
(Credit: 3.00)

MEC 4000
Project & Thesis - I
(Credit: 2.00)

Theoretical and experimental investigation of various topics in Mechanical Engineering. The topic should provide an opportunity for the student to develop initiative, creative ability and engineering judgment. Individual or group study (preferable not more than two in a group) will be required.

At the end of semester, the student is expected to complete the preliminary literature survey and select the topic for study- each student/group is expected to take part in the presentation of a least one seminar in the semester. The seminar/seminars will be conducted on their respective Thesis/Project topic.

4th Year 2nd Term

MEC 4229
Renewable Energy Technology
(Credit: 3.00)

Energy: Sources; world energy situation; energy situation in Bangladesh; prospect of different energy sources in Bangladesh, Energy cycle, Non-renewable energy sources, Coal, oil, natural gas, nuclear fuel, oil shale and tar sands. Renewable energy sources, solar, biomass, wind hydropower, geothermal, waves, ocean thermal and tidal.

Economic and environmental aspects of energy sources: Environmental impact of energy conversion – ozone layer depletion, global warming, greenhouse effect, loss of biodiversity, eutrophication, acid rain, air and water pollution, land degradation, thermal pollution, Sustainable energy, promising technologies, envelopment pathways. Energy Demand and supply.

Energy Conversion Techniques: Solar thermal conversion, semiconductor devices, Bio-chemical and Thermo-chemical conversion of biomass, bio-chemical and agro-chemical conversion of biomass- pyrolysis, gasification, combustion and fermentation, trans esterification, economics of biomass power generation, prospects wind energy conversion, hydropower, ocean thermal energy conversion.

Energy extraction: geothermal, waves, tides, nuclear fission and fusion. Energy Converting Devices and Storage: Thermoelectric, Fuel cells, Magneto hydrodynamics, Storage of solar energy, Demand of energy storage in stationary and transport applications.

Reference Book:

1. Zang, L. (Ed.). (2011). Energy efficiency and renewable energy through nanotechnology (p. 451). Berlin: Springer.
2. Hossain, J., & Mahmud, A. (Eds.). (2014). Renewable energy integration: challenges and solutions. Springer Science & Business Media.
3. Wengenmayr, R., & Bührke, T. (Eds.). (2011). Renewable energy: sustainable energy concepts for the future. John Wiley &Sons.

MEC 4231
Power Plant Engineering
(Credit: 3.00)

Power Plants: Introduction, power and industry, types of power plants, Electrical energy situation in Bangladesh.

Types of load and load curves: Effect of variable load on power plant design and operation, methods of meeting up variable load problem, forecasting of loads and electrical energy requirements, choice of generation; Power plant economics; rate and rate structures; Fundamental components of electrical energy transmission system.

Diesel power plants: Fields of use, layout, working principle of Diesel engine, fuel handling, Diesel engine accessories, Performance of diesel engines, Heat balance.

Steam power plants: Fields of use, layout, Steam generators, fuels and fuel handling, combustion equipment, conditioning of feed water and processed water.

Gas turbine power plants: Fields of use, layout, working principles, Regenerator, inter-cooling, and reheating, application of combined cycle and its performance.

Hydro-electric power plants: Water power, principle of utilization, hydrograph, mass curve, Types of reservoirs, site selection and sizing of hydraulic equipment, governing system.

Nuclear power plants: Fields of use, layout, types. Principles of nuclear energy generation. Nuclear fuels. Nuclear reactor systems and their working principles, safety analysis and waste disposal.

Power plant accessories: Cooling tower and spray ponds, Chimney design and foundation design.

Safety and Precautions: Starting, Operation and Stopping, Environmental impact analysis, Laws and regulation to implement power plant projects.

Tariffs of electricity.

Reference Book:

1. Nag, P. K. Power plant engineering. New Delhi, India: Tata McGraw-Hill, 2008.
2. Drbal, Larry, Kayla Westra, and Pat Boston, eds. Power plant engineering. Springer Science & Business Media, 2012.

MEC 4233

Industrial Management & Professional Ethics

(Credit: 3.00)

Management and Fundamentals: Brief history of the development of management theories, Management functions, Principles of Management.

Organization Fundamentals: Organization structure, Types of organization, Span of control.

Personal Management: Manpower planning, recruitment training, Leadership, style and types, Morale, Types and Importance, Motivation, Theories of Motivation, Job rotation, enlargement and enrichment.

Wages and Incentives: Job evaluation methods, wage incentive plans, Fringe Benefits.

Planning and Decision Making: Basic concept of Management information system (MIS) and Decision Support System (DSS), Strategic planning, importance and different steps, decision making process, Classification and procedure of decision making.

Budgeting: Budget, budget classification, budget revision and re-allocation, budgetary control, Types of expenditure and cost control through budgeting. Marketing, Marketing concepts, Modern marketing process, Purchase, purchasing procedure, purchasing methods, Sales, Industrial and Consumer selling, Distribution channel of goods, Sales promotion technique, Organization for purchasing and selling.

Research and Development: Research subjects, Developments of a new product or process, Product life cycle.

Professional Ethics:

Introductions, egoism and relativism, relativism Utilitarianism, rationalist Ethics, the Ethics of character and virtue.

Definition of morality and moral thoughts, responsibility, interpersonal moral sentiments (anger, blame, and praise), respect for persons, intrapersonal moral sentiments (shame and guilt), reason, emotion, and intuition in moral judgment, morality and religion, confidentiality, privacy and harassment.

Reference Book:

1. Khanna, O. P. Industrial engineering and management. Dhanpat rai publications, 1999.
2. Sharswood, George. An essay on professional ethics. Vol. 32. T. & JW Johnson, 1884.

MEC 40XX
Optional-III
(Credit: 3.00)

MEC 40XX
Optional-IV
(Credit: 3.00)

MEC 4000
Project & Thesis - II
(Credit: 4.00)

Theoretical and experimental investigation of various topics in Mechanical Engineering. The topic should provide an opportunity for the student to develop initiative, creative ability and engineering judgment. Individual or group study (preferable not more than two in a group) will be required.

A completed report will have to submit on the project and thesis at the end of the semester

OPTIONAL COURSES

MEC 4035
Advanced Thermodynamics
(Credit: 3.00)

Introduction: Review of Thermodynamic laws and principles. Availability and energy analysis of thermodynamic system; Interpretation of entropy, General thermodynamic relations. Properties of pure substances at different phases, the Clausius-Clapeyron equation. Equations of state and compressibility charts, Gibb's phase rule, Equilibrium and stability; Joule-kelvin effect and its application; Thermodynamics of magnetism; Magnetocaloric effect.

Chemical Thermodynamics (reactive system): Combustion reactions; enthalpy and entropy of formation; heat of fraction; adiabatic flame temperature; Irreversibility in combustion process; Chemical equilibrium of ideal gases.

Thermodynamics of Irreversible processes and direct energy conversion: Phenomenological laws and onsager reciprocity relation and their applications, Thermoelectric phenomena and its applications to thermoelectric energy conversion: Thermionic converters, Fuel cell and magneto hydrodynamic devices.

Reference Book:

1. Winterbone, Desmond, and Ali Turan. Advanced thermodynamics for engineers. Butterworth-Heinemann, 2015.
2. Annamalai, Kalyan, Ishwar K. Puri, and Milind A. Jog. Advanced thermodynamics engineering. CRC press, 2010.

MEC 4037
Automobile Engineering
(Credit: 3.00)

Basic Concept of Automobile: General Introduction to the automobile; components of the automobile; Engine types; Details of the engine construction; cylinder block and crank case, cylinder head, piston and piston rings, gaskets, crank shaft, cam shaft, valves and valve operating mechanism, valve position.

Fuel & Ignition System: Engine measurement and performance; fuel supply system, supply system, turbocharging, carburetion, Ignition Systems. Electronic advance system.

Lubrication & Cooling System: Lubricating system; cooling system Gasoline engine emission control.

Power Transmission System: Transmission system components from crank shaft to driving wheel; Differential and automatic transmission, torque converter; automobile body chassis and suspension system tires, front axle and steering system

Braking System: brakes and braking system, brake force, power brake.

Automobile Electric System: Storage battery construction, maintenance and chemistry, starter, motor, generator and auxiliary electric equipment, warning and indicating devices. Engine testing motor vehicle services, automobile air conditioning, Automobile of the future.

Reference Book:

1. Gupta, S. K. A Textbook of Automobile Engineering. S. Chand Publishing, 2020.
2. Rajput, R. K. A text book of automobile engineering. Firewall Media, 2008.

MEC 4039

Aerodynamics

(Credit: 3.00)

Introduction: Flow conservation equations, Review of ideal flow.

Dynamics of incompressible inviscid flow field: The Kelvin, Stokes and Helmholtz theorems. Elementary flows and their superposition.

Airfoil and Wing: Airfoil & Wing characteristics, aerodynamic forces and moment and their coefficients.

Incompressible flows around thin airfoils: Biot and Savart Law, Vortex line, Horse shoe Vortex.

Incompressible flow around wings: Prandtl's lifting line theory, induced angle, downwash, elliptic and general lift distribution, unswept & swept wings, twisted wing, wing body combinations.

Compressible subsonic flow: Linearized theory, compressibility corrections, Prandtl-Glauert equation, and the area rule.

Transonic flow: Von Karmann's stall equations, Transonic full potential equation, supercritical airfoils.

Supersonic airfoil and wing theory: Supersonic airfoil & wings, shock- expansion theory. A brief discussion on hypersonic aerodynamics.

Reference Book:

1. Anderson, John D. "Fundamentals of aerodynamics." McGraw (2009).
2. Flandro, Gary A., Howard M. McMahon, and Robert L. Roach. Basic aerodynamics: incompressible flow. Vol. 31. Cambridge University Press, 2011.

MEC 4041

Fluid Power Transmission and control

(Credit: 3.00)

Fluid Power Systems: Components, Advantages and its Industrial Applications. Transmission of Power at Static & Dynamic States. Properties of fluids. Selection of fluids, Additives. Seals, sealing materials, Selection of seals. Filters and Strainers, Sources of

Contamination of fluid & its Control. JIC Symbols/ISO Symbols for Hydraulic & Pneumatic Circuits.

Pumps: Type and functions of Vane pump, Gear pumps, Radial & Axial plunger pumps. Pump Characteristics Curves, Selection of Pumps for Hydraulic Power Transmission.

Accumulators & Intensifiers: Types & Functions of Accumulators, Intensifiers, Its Applications, Selection & Design Procedure.

Actuators: Linear & Rotary Actuators, Hydraulic motors; Types, Vane, Gear piston, Radial piston. Methods of control of Acceleration, Design Consideration for cylinders. Hoses & Pipes; Types, Materials, Pressure drop in Hoses and Pipes. Hydraulic Piping Connections and Branching.

Control of Fluid Power: Necessity of pressure control and Principle of operation, Pressure compensated and Temperature compensated flow control valves, Different ways and different positions valve, Directional and Flow control valves, Direct Operated, Pilot Operated, Relief valves, Pressure Reducing valve, Sequence valve, Servo valve & and their Functions. Manually operated and Solenoid operated Valve.

Pneumatics: Introduction to Pneumatic Power Sources, Reciprocating & Rota Compressors, Roots-Blower etc. Comparison of Pneumatics with Hydrau! Power Transmission. Air Preparation units, Filter, Regulators & Lubricator. Actuators, Linear Single & Double Acting Rotary Actuators, Air motors Pressure Regulating valves. Directional control valves two-way, three way & four way valves, Solenoid operated, Push button & Lever control valves. Flow control valves. Check valves and its Functions. Mechanical, Pneumatic & Electrical Power Control System. Pneumatic Circuits for Industrial Applications & Automation.

Reference Book:

1. Manring, Noah D., and Roger C. Fales. Hydraulic control systems. John Wiley & Sons, 2019.
2. Jagadeesha, T., and Thammaiah Gowda. Fluid Power: Generation, Transmission and Control. Wiley, 2013.

MEC 4043

Finite Element Method

(Credit: 3.00)

Introduction to Finite Element Analysis: Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis

Finite Element Formulation Techniques: Virtual Work and Variation Principle, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions. Element Properties, Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements. Basic matrix theory, potential energy approach, direct stiffness method, calculus of variations, development of finite element theory, and modeling techniques.

Applications in solid mechanics: Spring, Beam, Truss

Others Field of Application: Application of heat transfer, Application of fluids, and Application of electromagnetic devices, via both commercially available codes and student-written codes.

Reference Book:

1. Seshu, P. Textbook of finite element analysis. PHI Learning Pvt. Ltd., 2003.
2. Ebrahimi, Farzad, ed. Finite Element Analysis: Applications in Mechanical Engineering. BoD–Books on Demand, 2012.

MEC 4045

Industrial Automation

(Credit: 3.0)

Introduction to Automation: Automation and Manufacturing, Important of concept, Analog and Digital, Input and Output data, numbering system, Electrical power, pneumatics and Hydraulics, Continuous, Synchronous, and Asynchronous

Safety & Effectiveness: Processes Safety, Equipment Effectiveness

Automation Equipment: Controllers, Operator Interfaces, Sensors, Power Control, Distribution, and Discrete Controls, Actuators and Movement, AC and DC Motors, Mechanisms and Machine Elements, Structure and Framing

Processing System: Conveyors, Indexers and Synchronous Machines, Robots and Robotics, Part Feeders, Chemical Processing, Metal, Plastic, Ceramic, and Glass Processing, Food and Beverage Processing,

Sensors: Angular and Linear Position Sensors Sensor classification, Velocity and Acceleration Sensors, Contact sensor, Distance and velocity sensor, Automation Design and process specifications

Reference Book:

1. 1. S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, SecondEdition, Pearson Education
2. David Poole, Alan Mackworth, Randy Goebel,”Computational Intelligence: a logical approach”, Oxford University Press.
3. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem-solving”, Fourth Edition, Pearson Education.
4. 4. J. Nilsson, “Artificial Intelligence: A new Synthesis”, Elsevier Publishers.

MEC 4047

Operations Research

(Credit: 3.00)

Introduction: Origin and development of OR, Art of modeling, Assumptions, scope and limitations of OR models.

Linear Programming: Formulations (maximization and minimization) and graphical solution.

The Simplex Method: development of the simplex method, prima! Method, dual simplex method, special cases in simplex method app degeneracy, alternative optima, unbounded

solution, infeasible interpreting the simplex tableau, sensitivity analysis, optimum solution, resources, dual price (unit worth of a resource), maximum change in availability, maximum change in marginal profit/ cost.

Duality: definition of the dual problem, solution of the dual problem, relationship between primal and dual, objective values, optimal dual solution, economic interpretation of the dual problem, revised simplex method.

Transportation Model: Definition and applications of the transportation model, cases of balanced and unbalanced supply demand conditions, solution of the transportation problem; north west corner rule, vam, russels-approximation method; finding optimal solutions, the transshipment model.

Dynamic (Multistage) Programming: Elements of the DP Model, state, stage and decision variables; Forward and backward recursive equations, Examples of DP models and computations.

Decision Theory and Games: Decisions under risk, Decision trees, decisions under uncertainty, game theory; optimal solution of two-person zero-sum games, mixed strategies, graphical solution of (m x 2) and (2 x m) games.

Queuing Models: Basic elements of the queuing model, role of the Poisson and exponential distributions, pure birth and pure death processes, pure birth model, pure death model, queues with combined arrivals and departures, generalized Poisson model, steady-state measures of Performance, Specialized Poisson Queues; M/M/1(∞), M/M/1(k), M/M/c(∞), M/M/c(k), Queues with bulk arrivals, limitations of exact solution, approximate solution technique of queues.

Reference Book:

1. Taha, Hamdy A. "Operations Research an Introduction Tenth Edition Global Edition." (2017).
2. Hira, D. S. Operations research. S. Chand Publishing, 1992.

MEC 4049

Materials Handling & Maintenance Engineering

(Credit: 3.00)

Introduction: Importance of materials handling; Classification of conveying machines, Factors in selection conveying machines, Capacity of continuous conveyors, design fundamental, limit load concept.

Types of Conveyors: Belt, Apron, flight, bucket, swing try, car and platform conveyors, Roller conveyors, Oscillating and vibrating conveyors, Pneumatic and hydraulic conveyors, Safety of cranes and lift, Fork-lift, hopper, Chute Trucks.

Maintenance Engineering

Introduction: Necessity of maintenance, general properties and classification of different lubricants. viscosity and factors affection viscosity and other maintenance of common parts of plants, equipment, vehicle etc. maintenance of other sliding parts; maintenance of sealing parts (gasket, rubber seal, rubber ring), preparation of maintenance schedule for plants and machinery (boiler, turbine, pumps etc.) and execution of maintenance schedule, major faults

and repairing, preparation of maintenance schedule for agricultural pump, common major faults and repairing.

Reference Book:

1. Kulweic, Raymond A., ed. Materials handling handbook. John Wiley & Sons, 1991.
2. Stephens, Matthew P., and Fred E. Meyers. Manufacturing facilities design and material handling. Purdue University Press, 2013.

MEC 4051

Engineering Tribology

(Credit: 3.00)

Introduction: Introduction of Tribology, History of Tribology, Importance of Tribology, Tribological Failure Analysis.

Tribology in Solids: Structure and properties of solids, Surface roughness, Surface Engineering, Surface Examination and Characterization, Tribological properties of surface, contact between surfaces, Hertzian Contacts, Elliptical Hertzian Contacts, Real Area of Contact, Stationary Heat Sources, Moving Heat Sources, Nominal and Flash Heating, Deformation, Fracture and fatigue.

Friction: Friction, Possible causes of friction, Laws of friction, Friction between elastic bodies, Experimental measurement of friction. The Friction of Solids.

Wear: Mechanisms of Wear, Types of wear, Adhesive wear, Abrasive wear, Fatigue wear, Impact wear, Corrosive wear, Scuffing, Fretting, Wear debris, Wear measurements. Wear Analysis Process, Wear Testing, and Wear Modeling and Mapping.

Lubrication: Lubricant types and their compositions, Properties of lubricss, Measurement of viscosity, Additives, Lubrication and lubricatio Viscous flow, One- and Two-Dimensional Reynolds equation lubrication, Boundary lubrication, Hydrostatic Bearings, Hydrodyn and Journal Bearings. Elasto hydrodynamic Lubrication, Roll Bearings, Heroic Tribology, Solid Lubricants.

Tribological components: Bearings, Performance and selection of bearing, seals, Gears, Micro components, Material processing.

Reference Book:

1. Stachowiak, Gwidon, and Andrew W. Batchelor. Engineering tribology. Butterworth-heinemann, 2013.
2. Stachowiak, Gwidon, and Andrew W. Batchelor. Engineering tribology. Butterworth-heinemann, 2013.

MEC 4053

Modern Manufacturing Processes

(Credit: 3.00)

Familiarization and Operation of various Modern Manufacturing Machines: Theory & application of Machining by Abrasive jet, Ultrasonic, water jet, Abrasive flow, Thermal assistance; Total Form machining & Low stress grinding. Electrochemical machining & grinding, polishing, sharpening, honing & turning; Electrochemical Discharge Grinding, electro stream & shaped Tube electrolytic machining; Chemical & Thermo-chemical machining. Thermal energy methods in material processing (Machining/welding/heat treatment) by Electro discharge; laser & electron beam; Plasma arc & ion beam. Physical vapor Deposition; Chemical vapor deposition & plasma spraying. High Energy Rate Forming & electroforming.

Reference Book:

1. Koç, Muammer, and Tugrul Özel, eds. Modern manufacturing processes. John Wiley & Sons, 2019.
2. Brown, James A. Modern manufacturing processes. Industrial Press Inc., 1991.

MEC 4055

Artificial Intelligence

(Credit: 3.00)

Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

Searching: Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A*, AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions. Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules-based deduction systems

Logics: First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, learning from observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning.

Expert systems: Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success factors, types of expert systems, expert systems and the internet interacts web, knowledge engineering, scope of knowledge, difficulties, in

knowledge acquisition methods of knowledge acquisition, machine learning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impacts reasoning in artificial intelligence, inference with rules, with frames:

Reference Book:

1. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education
2. David Poole, Alan Mackworth, Randy Goebel,"Computational Intelligence: a logical approach", Oxford University Press.
3. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem solving", Fourth Edition, Pearson Education.
4. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers

MEC 4057
Robotics & Mechatronics
(Credit: 3.00)

Introduction: History, Overview, Classification, specification and application, Future directions, elements, Sensors.

Components: Manipulator arm, End effectors, Actuators, Transmission

Manipulator Kinematics: Spatial descriptions and transformation, Manipulator kinematics, Inverse manipulator kinematics, Velocities and static forces. Manipulator Dynamics: Newton's equation, Euler's equation, Lagrange formulation; formulating manipulator dynamics in Cartesian space, Dynamic simulation and computational consideration.

Trajectory Generation: General considerations in path description and generation, Joint space schemes, Cartesian space schemes, path generation at run time, planning of paths using the dynamic model. Control: Basic concept, Transfer functions; Position control, Force control. Robot Programming and languages: Requirements, Operating systems, teaching; Languages.

Introduction to Mechatronics: Basic Concepts of Mechatronics, Fields of Mechatronics

Reference Book:

1. Renfrew, Alasdair. "Introduction to robotics: Mechanics and control." International Journal of Electrical Engineering & Education 41.4 (2004): 388.
2. Lynch, Kevin M., and Frank C. Park. Modern robotics. Cambridge University Press, 2017.

MEC 4059
Mechanical Vibration
(Credit: 3.00)

Introduction: Basic Concepts of Vibration, Classification of Vibration, Vibration Analysis Procedure, Spring Elements, Mass or Inertia Elements, Damping Elements, Harmonic Motion, Harmonic Analysis

Free Vibration: Introduction to Free Vibration of Single-Degree-of-Freedom Systems, Free Vibration of an Undammed Translational System, Free Vibration of an Undamped Torsional System, Response of First-Order Systems and Time Constant, Rayleigh's Energy Method, Free Vibration with Viscous Damping.

Harmonically Excited Vibration: Introduction to Harmonically Excited Vibration, Equation of Motion, Response of an Undamped System Under Harmonic Force, Response of a Damped System Under Harmonic Force, Response of a Damped System Under $F^1t^o = F0$ $\exp^1i\omega t^o$, Response of a Damped System Under the Harmonic Motion of the Base, Response of a Damped System Under Rotating Unbalance, Forced Vibration with Coulomb Damping, Forced **Vibration with Hysteresis Damping**: Forced Motion with Other Types of Damping, Self-Excitation and Stability Analysis, Response Under a General Periodic Force, Response Under a Periodic Force of Irregular Form, Response Under a Nonperiodic Force, Convolution Integral, Response Spectrum, Laplace Transforms, Introduction to Two DOF Systems, Equations of Motion for Forced Vibration, Free-Vibration Analysis of an Undamped System, Torsional System, Coordinate Coupling and Principal Coordinates, Forced Vibration Analysis, Semi definite Systems, Self-Excitation and Stability Analysis, Transfer-Function Approach, Solutions Using Laplace Transform, Solutions Using Frequency Transfer Functions

Reference Book:

1. Haberman, Richard. Mathematical models: mechanical vibrations, population dynamics, and traffic flow. Society for Industrial and Applied Mathematics, 1998.
2. Rao, Singiresu S. Mechanical vibrations. 2001.

MEC 4061
Nanomaterial & Nanotechnology
(Credit: 3.00)

Introduction: Perspectives of Nanotechnology, History of nanomaterial, some present and future applications of nanomaterial.

Preparation/Synthesis of nanomaterial: Methods for creating nanostructures, Nano materials: Montmorillonite organoclays (MMT), Carbon nanofibers (CNFs), Carbon nanotubes, Graphite nanoplatets, Nano silica, Nonaluminum oxide, Nano titanium oxide, Nano silver

Characterization of nanostructures: Challenges in characterizing nano-sized materials, Common characterization techniques for nanomaterial: Wide-angle X-ray Diffraction (WAXD), Scanning Electron Microscope, Transmission Electron Microscopy (TEM), X-ray Photoelectron Spectroscopy (XPS), Raman Spectroscopy, Atomic force microscopy (AFM), Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS), Raman Spectroscopy, Fourier Transform Infrared Spectroscopy.

Properties of materials due to the scaling of size: Nano Optics, Nano Electronics, Nano Magnetism. Nano Mechanics: Mechanical oxide (GO) properties of Carbon nanofibers (CNF), Carbon nanotubes (CNT), Graphemes

Fields of Applications: Catalysis, Drug delivery devices, Structural materials such as for aerospace technology, Automotive body structural applications, Thermal interface materials, Microwaves absorbing materials, Sensor & actuator applications, Fuel Cell & battery applications.

Reference Book:

1. Cerqueira, Miguel Angelo Parente Ribei, et al., eds. "Nanomaterials for food packaging: materials, processing technologies, and safety issues." (2018).
2. Vedangi, Geetika Spandana. Improvement of Mechanical and Hydrophobic Properties of Nanotube Reinforced Glass-Fiber Composites. California State University, Long Beach, 2020.

MEC 4063
Industrial Safety
(Credit: 3.00)

Introduction: Introduction to OSHA and WISHA, Workers Compensation Accidents and Their Effects, Consensus Standards Theories of Accident Causation, The OSHA Act, Standards, and Liability OSHA WISHA Inspections, Violations, Citations, Appeals Ergonomic Hazards and Repetitive Strain, Late Night Retail -Violence Prevention / Motor Vehicle Safety Uniform Building Codes, International Building Codes Falling Hazards / Walking and Working Surfaces, Machine Guarding

Hazards: Lockout-Tag out Electrical Hazards Fire and Emergency Egress, Confined Spaces, Welding, Noise, Respiratory Protection. Chemical Hazard Communication, MSDS / Asbestos Storage of Flammable Materials

Safety: Fire Codes Blood borne Pathogens Industrial Hygiene / Process Safety Management Forklift Safety Personal Protective Equipment PPE Hazard Assessment Hard Hats, Safety Glasses, Harnesses, Safety Boots/ OSHA Recordkeeping / Emergency Eyewash / Heat Stress Ladder Safety / Scaffold Safety Accident and Incident Investigation Root Cause Analysis, Accident Prevention.

Accident Management Strategy, Concept of Safety culture, Evaluation methods for safety culture

Reference Book:

1. Macdonald, D. (2003). Practical industrial safety, risk assessment and shutdown systems. Elsevier.
2. Reese, C. D. (2008). Industrial safety and health for administrative services. CRC Press.
3. Deshmukh, L. M. (2005). Industrial Safety Management: Hazard Identification and Risk Control. McGraw-Hill Education.

MEC 4065
Project Management and Leadership
(Credit: 3.00)

Introduction: Why Project Management? Constraints, Project Management Cycle, Project Management Processes (Core & Supportive), Project Management Roles, Differences Project Management Skills, Project Management Methodologies.

Organizational Context: Strategy, Structure, and Culture, Project Selection and Portfolio Management, Leadership and the Project Management, Adaptive Project Management, Project Team Building, Conflict, and Negotiation Scope, Resources, and Schedule, Risk Management Estimation, Budgeting, Project Management Control Systems

Project Scheduling: Networks, Duration, and Critical Path, Lagging, Crashing, & Activity Networks, Resource Management. Project Monitoring and Control, Useful Implementation Tools.

Project Management Principles: Management of project planning, Funding and financing models for project, Turnkey, BOO, BOOT, Project evaluation techniques including ratio analysis, break-even analysis, liquidity analysis, and sensitivity analysis; Public sector project approval process, Terms of payment. Incentives and damages terms, Scheduling of the project and challenges of schedule management.

Project Management Contract: Types of Contract; Contract administration; Technical bid evaluation and award of contracts; Contract Strategy. Number and scope of contracts and sub-contracts.

Reference Book:

1. Crawford, J. K. (2006). Project management maturity model. Auerbach Publications.
2. Harrison, F., & Lock, D. (2017). Advanced project management: a structured approach. Routledge.
3. Gray, C. F., Larson, E. W., & Desai, G. V. (2008). Project management: The managerial process (Vol. 97). New York: McGraw-Hill/Irwin.

MEC 4067
Nuclear Power Plant Engineering
(Credit: 3.00)

Introduction: Concept of Nuclear Reactions, Control of Nuclear Reactions, Fissile and Fertile Materials, Fuel Enrichment, Coolant, Moderator, Reactivity, Reactivity Control, Burnable poison, Heat removal process.

Reactors: Evolution History of Nuclear Reactors with Different Generation, Working Concept of Pressurized Water Reactor, Boiling Water Reactor, Pressurized Heavy Water Reactor, Gas-cooled reactor, Liquid Metal cooled reactors, Fast Breeder reactors and Advanced Reactor Concept.

Nuclear Waste: Concept of fuel cycles, Types of radioactive wastes, Disposal technique and methods of intermediate and high-level wastes.

Reactor Safety: Safety objective, Safety function, Safety principle, Safety Standard, Active and Passive safety, Inherent safety, engineered safety, Safety Assessment methods

Reference Book:

1. Shultis, J. Kenneth, and Richard E. Faw. Fundamentals of Nuclear Science and Engineering Third Edition. CRC press, 2016.
2. Lamarsh, John R., and Anthony John Baratta. Introduction to nuclear engineering. Vol. 3. Upper Saddle River, NJ: Prentice hall, 2001.
3. Md. Shafiqul Islam, Nuclear Power in Bangladesh and Beyond, UGC (2022).

MEC 4069
Power Plant Economics
(Credit: 3.00)

Introduction to Energy Markets: History of energy resources, Energy Statistics, Regulation and Competition in Energy Markets both local and international.

Fundamentals of Economics: Definition of economics, Micro vs. Macro Economics, Positive vs. Normative Economics, Economic Models; Circular Flow Diagram and Production Possibilities Frontier, Ten Principles of economics, Market, Competition, Supply and Demand, Keynesian economics, Keynesian multiplier effect, Business-As-Usual (BAU) model.

Basic Parameters of Power Plant Economics: Capital expenditures (CAPEX), Operational expenditures (OPEX), O&M costs; Fixed costs and variable costs, Relationship between OPEX and O&M costs, Components under CAPEX and OPEX, Weighted Average Cost of Capital (WACC), Plant capacity factor, Plant utilization factor, Based load plant

Financial and Economic Parameters of Power Plants: Financial parameters, Economic parameters, Financial vs Economic analysis of a power plant project, Discount rate, Discounting formula, Overnight construction costs, Interest during construction (IDC), Project profitability parameters; Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR), and Pay Back Period (PBP), Different types of cost concepts, Engineering, procurement, and construction (EPC) project cost, Turnkey cost, Levelized cost of electricity generation (LCOE)

Solving Financial and Economic Analysis of a Power Project: Calculation and analysis of LCOE of NPPs both theoretical and modelling methods, Analysis of NPV, IRR, and PBP, BCR, Sensitivity analysis during construction and operational cases of a power plant

Variability Study: Variation of CAPEX, OPEX, Discount factor, and plant capacity factor over renewable, fossil fuel, and nuclear energy-based plants, Affect CAPEX, OPEX, Discount factor, plant capacity factor etc. over LCOE for different energy-based power plants.

Reference Book:

1. Bhattacharyya, S. C. (2019). Energy economics: concepts, issues, markets and governance. Springer Nature.
2. Rothwell, Geoffrey S. "01305. Economics of Nuclear Power versus Other Energy Sources."
3. Kirschen, Daniel S., and Goran Strbac. Fundamentals of power system economics. John Wiley & Sons, 2018.