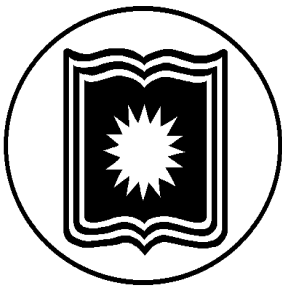
Department of Materials Science and Engineering

University of Rajshahi



Faculty of Engineering

Syllabus for B.Sc. Engg. Degree in Materials Science & Engineering (MSE)

Session 2013-2014

Year of Examinations:

B.Sc. Engg. Part-I	**2014**
B.Sc. Engg. Part-II	**2015**
B.Sc. Engg. Part-III	**2016**
B.Sc. Engg. Part-IV	**2017**

Materials Science and Engineering, a brief introduction: Materials Science and **Engineering** is one of the most important, lucrative and utility subject of modern science. Nowadays, the subject is considered as the barometer of the development of a country. Materials Science and Engineering deals with the processing, designing, characterizing the materials, developing new materials, producing cost effective materials and application of the materials useful in structures, machines and devices of technological importance and includes metals, ceramics, alloys, composites, polymers, textiles, biomaterials, etc. From a simple hammer to complicated units of a computer, from the materials of a cart to most sophisticated components of a space craft; biological, biochemical and pharmaceutical products and medical instruments, all have resulted from proper study and research on materials science and its application. Therefore, materials science has emerged as a separate discipline out of chemistry, physics and engineering, some fifty years ago. Considering the importance of materials education and research in a developing country like Bangladesh the Department of Materials Science and Engineering has recently been established at the University of Rajshahi as a unique Department in Bangladesh by its name, although there is a Department of this type, naming Department of Materials and Metallurgical Engineering at Bangladesh University of Engineering and Technology.

The Department started functioning as the name of the **Department of Materials Science and Technology** in a new discipline in 2004 in the Fourth Science building under the Chairmanship of Dr. C. M. Mostofa (in deputation), a Professor of the Department of Applied Chemistry and Chemical Engineering, R.U. with a batch of 17 Honours students admitted into the first year (Hons.) in the academic session 2003-2004. The present name, the **Department of Materials Science and Engineering** has been functioning from 31st December 2009. The former chairman (in deputation), Dr M Mozibur Rahman, Professor of Physics R.U. reorganized the course curricula for engineering degree. At present the Department offers four-year B.Sc. Engineering (Residual four-year B.Sc. honours courses are also running parallel), one-year M.Sc., two-year M.Phil. and three-year Ph.D. courses. Graduates with science or engineering background can apply for admission into M.Phil. and Ph.D. programmes in materials science and engineering.

The present enrolment of students at the B.Sc. Honours level is about 80. At present there are 19 regular teaching staff, 1 officer and 10 supporting technical and office staff assisting smooth running of the Department. A list of the Faculty members is given below:

Associate Professor:

1.	Dr. Md. Asadul Haque* *B.Sc.Honours, M.Sc.(Rajshahi), Ph,D.(Japan)*	Polymer Chemistry and Instrumentation
2.	Dr. Md. Saidul Islam *B.Sc.Honours, M.Sc.(Rajshahi), Ph,D.(Japan)*	Ceramic Materials
3.	Dr.G. M. Shafiur Rahman *B.Sc.Honours, M.Sc.(Rajshahi). Ph.D (Japan)*	Polymeric, Textile and Composite Materials

Assistant Professor:

4.	Dr. Jahanara Nasrin *B.Sc.Honours, M.Sc.(Rajshahi)*	Metallurgy
5.	Mr. M. Abdul Matin* *B.Sc.Honours, M.Sc.(Rajshahi)*	Polymeric, Textile and Composite Materials
6.	Mr. Abu Mahmud *B.Sc.Honours, M.Sc.(Rajshahi)*	Polymers and Biomaterials

Lecturer:

7.	Dr. Md. Anwarul Kabir Bhuiya *B.Sc.Honours, M.Sc.(Rajshahi) Ph.D (Japan)*	Nanotechnology
8.	Mr. Md Abdul Halim* *B.Sc.Honours, M.Sc.(Rajshahi)*	Thin Solid Films
9.	Mr. Mijanur Rahaman* *B.Sc.Honours, M.Sc.(Rajshahi)*	Superconductivity
10.	Mr. Mirza Humaun Kabir Rubel* *B.Sc.Honours, M.Sc.(Rajshahi)*	Glass-ceramic
11.	Mr. Md.Abdus Sattar* *B.Sc.Honours, M.Sc.(Rajshahi)*	Thin Solid Films
12.	Md. Emrul Kayesh *B.Sc.Honours, M.Sc.(Rajshahi)*	Glass Ceramics
13.	Mst. Jesmin Sultana *B.Sc.Honours, M.Sc.(Rajshahi)*	Corrosion
14.	Muhammad Abdullah Al Mamun *B.Sc.Honours, M.Sc.(Rajshahi)*	Composite Materials
15.	Md, Shahnawaz Parvez *B.Sc.Honours, M.Sc.(Rajshahi)*	Advance Ceramics
16.	Gagi Tauhidur Rahman *B.Sc.Honours, M.Sc.(Rajshahi)*	Bio-Inorganic materials
17.	Shammi Farhana Islam *B.Sc.Honours, M.Sc.(Rajshahi)*	Electronics
18.	Md. Ashadul Islam *B.Sc.Honours, M.Sc.(Rajshahi)*	Biomaterials
19.	Md. Earul Islam *B.Sc.Honours, M.Sc.(Rajshahi)*	Sensors & Electronics

*** On leave**

Distribution of Credits in Materials Science & Engineering Courses:

Total Credits of Materials Science & Engineering Courses:	**160**	Credits
Humanities:	**8**	Credits
1) English	2	,,
2) Economics	2	,,
3) Management and Accounting	2	,,
4) Law and Professional Ethics	2	,,
Mathematics and Basic Sciences:	**31**	Credits
1) Mathematics	9	,,
2) Physics	11	,,
3) Chemistry	9	,,
4) Statistics	2	,,
Basic and Major Engineering Courses: (Theory: **87** Credits and Laboratory: **34** credits)	**121**	credits
Basic Engineering:	**12**	Credits
1) Fundamental of Electrical Engineering	3	,,
2) Computer operating Systems and Programming C/C++	3	,,
3) Engineering Drawing & Graphic Lab	2	,,
4) Mechanical Engineering Workshop Lab	2	,,
5) Computer Programming Lab	2	,,
Materials Science & Engineering (Major courses):	**109**	Credits

Course Crriculum for
Bachelor of Science in Materials Science and Engineering [B.Sc. Engg. (MSE)] Degree
Faculty of Engineering, University of Rajshahi

B. Sc. Engg. Part-I, Odd Semester, Session 2013-2014

Course No.	Course Title	Units	Credits	Marks
MSE1111	Introduction to Materials Science & Engineering	0.75	3	75
MATH1111	Algebra , Trigonometry & Vector Analysis	0.75	3	75
PHY1111	Mechanics & General Properties of Matter, Waves and Sound	0.75	3	75
CHEM1111	Physical and Inorganic Chemistry	0.75	3	75
ENG1111	Technical English	0.50	2	50
MSE1112	Qualitative and Quantitative Analysis of Materials **(Lab)**	0.50	2	50
CHEM1112	Physical Chemistry (**Lab)**	0.50	2	50
MSE1122	Mechanical Engineering Workshop **(Lab)**	0.50	2	50
	Total	5.00	20	500

B. Sc. Engg. Part-I, Even Semester, Session 2013-2014

Course No.	Course Title	Units	Credits	Marks
MSE1211	Crystallography and Structure of Materials	1.00	4	100
PHY1221	Applied Electricity & Magnetism	0.75	3	75
MATH1211	Differential and Integral Calculus	0.75	3	75
STAT1211	Statistics for Engineers	0.50	2	50
ECON1211	Economics	0.50	2	50
MSE1212	Crystallography **Lab**	0.50	2	50
MSE 1222	Engineering Drawing and Graphics **Lab**	0.50	2	50
MSE1210	Viva-Voce	0.50	2	50
	Total	5.00	20	500

B. Sc. Engg. Part-II, Odd Semester, Session 2014-2015

Course No.	Course Title	Units	Credits	Marks
MSE2111	Polymeric Materials	0.75	3	75
MSE2121	Basic Quantum Mechanics	0.50	2	50
MSE2131	Electronic Properties of Materials	0.75	3	75
MATH2111	Matrices and Differential Equations	0.75	3	75
PHY2111	Basic Electronics and Instrumentations	0.75	3	75
ACCO2111	Industrial Management and Accountancy	0.50	2	50
MSE2112	Polymer Synthesis and Characterisation **Laboratory**	0.50	2	50
PHY2112	General Physics **Laboratory**	0.50	2	50
	Total	5.00	20	500

B. Sc. Engg. Part-II, Even Semester, Session 2014-2015

Course No	Course Title	Units	Credits	Marks
MSE2211	Materials Thermodynamics and Kinetics	0.50	2	50
MSE2221	Materials for Energy Conversion and Storage	0.50	2	50
MSE 2231	Fundamentals of Electrical Engineering	0.75	3	75
CSE2241	Computer Fundamentals and Programming in C & C++	0.75	3	75
CHEM2211	Organic Chemistry	0.50	2	50
LAW2211	Law and Professional Ethics	0.50	2	50
CSE2212	Computer Programming and Electrical **Laboratory**	0.50	2	50
CHEM2212	General Chemistry **Laboratory**	0.50	2	50
MSE2210	Viva-Voce	0.50	2	50
	Total	5.00	20	500

B. Sc. Engg. Part-III, Odd Semester, Session 2015-2016

Course No.	Course Title	Units	Credits	Marks
MSE3111	Phase Diagram and Microstructure of Materials	0.75	3	75
MSE3121	Glass and Ceramics	0.75	3	75
MSE3131	Composite Materials	0.75	3	75
MSE3141	Mechanical Behaviour of Materials	0.75	3	75
MSE3151	Production Metallurgy	0.50	2	50
MSE3112	Glass and Ceramic Processing **Laboratory**	0.50	2	50
MSE3122	Mechanical Property Testing **Laboratory**	0.50	2	50
MSE3132	Metallography and Microstructure **Laboratory**	0.50	2	50
	Total	**5.00**	**20**	**500**

B. Sc. Engg. Part-III, Even Semester, Session 2015-2016

Course No.	Course Title	Units	Credits	Marks
MSE3211	Physical Metallurgy	0.75	3	75
MSE3221	Materials Manufacturing Engineering	0.75	3	75
MSE3231	Corrosion Science and Engineering	0.75	3	75
MSE3241	Electrochemical Science and Engineering	0.75	3	75
MSE3251	Construction Materials	0.50	2	50
MSE3212	Electrochemical and Corrosion **Laboratory**	0.50	2	50
MSE3222	Industrial Project **(Laboratory)**	0.50	2	50
MSE3210	Viva-Voce	0.50	2	50
	Total	**5.00**	**20**	**500**

B. Sc. Engg. Part-IV, Odd Semester, Session 2016-2017

Course No.	Course Title	Units	Credits	Marks
MSE4111	Microscopic Methods in Materials Characterisation	0.75	3	75
MSE4121	Plastic and Rubber Technology	0.75	3	75
MSE4131	Magnetic, Dielectric and Semiconducting Materials	0.75	3	75
MSE4141	Waste Management, Industrial Safety and Environmental Issues	0.75	3	75
MSE4151	Surface Engineering and Coating	0.50	2	50
MSE4112	Metallurgical **Laboratory**	0.50	2	50
MSE4122	Polymer Processing **Laboratory**	0.50	2	50
MSE4132	Electronic Materials **Laboratory**	0.50	2	50
	Total	**5.00**	**20**	**500**

B. Sc. Engg. Part-IV, Even Semester, Session 2016-2017

Course No.	Course Title	Units	Credits	Marks
MSE4211	Introduction to Nano and Biomaterials	0.75	3	75
MSE4221	Spectroscopic Analysis of Materials	0.75	3	75
MSE4231	Welding and Joining Technology	0.50	2	50
MSE4241	Engineering Materials	0.50	2	50
MSE4251	Fibre Technology	0.50	2	50
MSE4212	Welding and Joining **Laboratory**	0.50	2	50
MSE4222	Computer Aided Engineering Drawing & Designing **Laboratory**	0.50	2	50
MSE4232	Research Project **(Laboratory)**	0.50	2	50
MSE4210	Viva-Voce	0.50	2	50
	Total	**5.00**	**20**	**500**

Pre-Requisite Courses:

Course No.	Course Title	Units	Credits	Marks
MSE2121	Basic Quantum Mechanics	0.50	2	50
MSE2131	Electronic Properties of Materials	0.75	3	75
MSE2211	Materials Thermodynamics and Kinetics	0.50	2	50
MSE2241	Computer Fundamentals and programming in C & C++	0.75	3	75

Optional Courses:

Course No.	Course Title	Units	Credits	Marks
MSE2221	Materials for Energy Conversion and Storage	0.50	2	50
MSE32xx	Electronics Materials	0.50	2	50
MSE3251	Construction Materials	0.50	2	50
MSE4141	Waste Management, Industrial Safety and Environmental Issues	0.50	2	50
MSE4251	Fibre Technology	0.50	2	50
MSE42xx	Computational Materials Science	0.50	2	50
MSE42xx	Carbon Materials Technology	0.50	2	50

Course Descriptions for B. Sc. Engg. in MSE
Session 2013-2014

Part-I Examination, 2014
(Odd Semester)

MSE1111 Introduction to Materials Science and Engineering

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Understanding of Materials:** An introduction to basic concepts of materials science and engineering, development of materials, classification of materials and their characteristics, uses of materials, selection of materials in view of service and fabrication requirements and economics; chemical, physical and mechanical properties of materials, factor influencing properties, scope and application of materials science and engineering.
2. **Types of Solid Materials:** Metal, polymer, ceramics, composites, semiconductor, crystalline & amorphous solids, Superconductor.
3. **Solidification of Materials:** Introduction, Nucleation and growth of Crystal, Homogeneous and heterogeneous nucleation, Types of Solid solution, Ordered and disordered solid solution, Grain and grain boundaries, Effect of cooling rate on grain size and mechanical properties.

Section-B

4. **Diffusion in Solids:** Diffusion mechanisms, steady-state & nonsteady-state diffusions, factors that influence diffusion, other diffusion path.
5. **Defects in Solid:** Introduction**,** Types of defect, Point and Schotky defects.
6. **Electrical and Thermal Properties of Materials:** Ohm's law, electrical conductivity, energy band structures in solids, Electrical conduction in metals, semiconductor and alloys, Electron mobility, Electrical characteristics of ceramics & polymers, Heat capacity, Thermal expansion, Thermal conductivity and Thermal stresses.
7. **Mechanical Properties of Materials:** Stress and strain; elastic, plastic and viscous behaviour.

Recommended Books:

	Authors' name	Title
1.	William D. Callister	Materials Science & Engineering – An Introduction
2.	William F. Smith	Foundation of Materials Science and Engineering
3.	L.H. Van Vlack	Elements of Materials Science and Engineering
4.	R.B. Gupta	Materials Science
5.	K. Easterling	Tomorrow's Materials
6.	J.C. Anderson, K.D. Leaver, R.D. Rawlings & J.M. Alexander	Materials Science

MATH1111 Algebra, Trigonometry and Vector Analysis

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. Algebra of sets, De Morgan's rule, relation & function. Determinants: Properties and Cramer's rule.
2. Theory of Equations: Theorem, and relation between roots and coefficients, Solution of cubic equations.
3. De Moiver' theorem. Deduction from De Moiver's theorem.

Section-B

4. Functions of complex arguments. Gregory's series. Summation of series. Hyperbolic functions.
5. Vector Addition, Multiplication & Differentiation.
6. Definitions of line, surface and volume integral. Gradient of scalar function, Divergence and curl of vector function. Physical significance of gradient, divergence and curl. Integral forms of gradient, divergence and curl, Divergence Theorem, Stoke's theorem, Green's theorem and Gauss's theorem.

Recommended Books:

Text Books:

	Authors' name	Title
1.	H.S.Hall and S.R. Knight	Higher Algebra
2.	B.C.Das and B.N.Mukherjee	Higher Trigonometry
3.	M. R. Spiezel	Vector Analysis

Reference Books:

	Authors' name	Title
1.	Barnside and Panton	Theory of Equations
2.	Barnside and Child	Higher Algebra
3.	M.A. Sattar	Higher Trigonometry
4.	M. A. Sattar	Vector Analysis

PHY1111 Mechanics, General Properties of Matter, Waves and Sound

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section- A

1. **Rotational Motions:** Rotational variable; rotation with constant angular acceleration; relation between linear and angular kinematics, torque on a particle; angular momentum of a particle; kinetic energy of rotation and moment of inertia; combined translation and rotational motion of a rigid body; conservation of angular momentum.
2. **Oscillatory Motions:** Hooke's law and vibration; simple harmonic motion; combination of harmonic motions; damped harmonic motion.
3. **Surface Tension:** Surface tension as a molecular phenomenon; surface tension and surface energy; capillary rise or fall of liquids; pressure on a curved membrane due to surface tension.
4. **Elasticity:** Moduli of elasticity, Poisson's ratios; relations between elastic constants and their determination; cantilever.

Section B

5. **Fluid Dynamics:** Viscosity and coefficient of viscosity, Posseulle's equation; Bernoulli's theorem and its applications, Torricelli's theorem; venturimeter.
6. **Waves in Elastic Media:** Mechanical waves, types of waves, superposition principle, wave velocity; power and intensity in wave motion; interference of waves; complex waves; standing waves and resonance.
7. **Sound Waves:** Audible, ultrasonic and infrasonic waves, propagation and speed of longitudinal waves; vibrating systems and sources of sound; beats; Doppler effects.

Recommended Books:

	Authors' name	Title
1.	Ahmed & Nath	Mechanics and Properties of Matter
2.	Emran et al	General Properties of Matter
3.	Halliday & Resnick	Physics (Part-I & II)
4.	Mathur	Elements of Properties of Matter
5.	Newman & Searle	General Properties of Matter
6.	Spiegel	Vector Analysis
7.	Symon	Mechanics
8.	Emran	Text Book of Sound
9.	Coulson	Waves
10.	Wood	Text Book of Sound

CHEM1111 Physical and Inorganic Chemistry

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. Electrochemistry (10 Lectures): Conductors, Electrolytes and Electrolysis; Faradays Laws of Electrolysis and their significance. Ohm's law and electrolytic conductances; Theories for electrolytic conductance (Arrhenius

& Debye-Hükel). Ionic mobility, Kohlrausch's law, Tranference Number and its determination; Activities, activity coefficient and Debye-Hükel limiting law.Electrochemical cells(Electrolytic and Galvanic/Voltaic):Electrode reaction and potentials. Reference electrodes; Reversible and concentration cells,Storage Batteries(or accumulators).

2. **Chemical Equilibrium and Kinetics (10 lectures):** Equilibrium and Equilibrium constants, Kc, Kp, Kx. Rate of reaction and rate constants; Le Chatelier principle and its application. Order and molecularity of a reaction; integrated rate expressions & half- lives of zeroeth, first and second order reactions. Determination of order & temperature dependence of a reaction; energy of activation and Arrhenius equation. Transition-state theory of reaction rates. Characteristics of catalysis, promoters and inhibitors.
3. **Surface Chemistry and Colloids (10 lectures):** Adsorption and sorption; Characteristics of physical and chemical adsorptions. Fruendlich, Langmuir and Gibb's Adsorption isotherms; The BET equation. Crystalloids, Colloids and their classification, preparation, properties (kinetic, colligative, optical & electrical) and importance,=. Original pf charge and stability of colloids (sols), Gold number; colloidal electrolytes. Elementary idea about emulsions and gels.

Section-B

4. **Atomic structure and Periodic Table (10 lectures):** Modern concept of atomic structure and Periodic Table; related principles and Laws. Constitution and Periodic properties of elements (ionization potential, electronigativety, electron affinity, atomic and ionic radii). Grouping of elements, their properties and uses. Isotopes and radioactivity.
5. **Electronic Theory of Valency and Chemical Bonding (8 lectures):** Different types of bonds (ionic, covalent, co-ordinate, hydrogen and metallic) Classification of solids on the basis of bonding and their properties. Atomic orbitals and their hybridization; valency bond and Molecular orbital theories.
6. **Chemistry of Transition Elements, Lanthanides and Actinides (7 lectures):** Definitions, electronic configurations, preparations (nuclear transformations), general properties and uses.

Recommended Books:

Text Books:

	Authors' name	Title
1.	R. D. Madan	Modern Inorganic Chemistry
2.	M. M. Haque and M. A. Nawab	Principles of Physical Chemistry
3.	E. S Gilreath	Fundamental Concepts in Inorganic Chemistry

Reference Books:

	Authors' name	Title
1.	G. M. Barrow	Physical Chemistry
2.	W. J. Moore	Physical Chemistry
3.	K. J. Laidler and J.H. Meiser	Physical Chemistry
4.	S. R. Palit	Elementary Physical Chemistry
5.	S. Z. Haider	Modern Inorganic Chemistry
6.	Companion	Chemical Bonding
7.	Cotton, Wilkinson & Jones	Basic Inorganic Chemistry
8.	D. K. Sebera	Electronic Structure and Chemical Bonding

ENG1111 Technical English

Full Marks:50, credits:2, [Exam: 70%, Quizzes/Class Tests :20%, Attendance: 10%]
Unit:0.5, Lectures:2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Grammar**: Grammatical principles, modals, phrases & idioms, prefixes & suffixes, sentence structures, wh & yes/ no questions, conditional sentences.
2. **Vocabulary**: Technical & scientific vocabulary, defining terms.
3. **Spoken English**: Introduction to phonetic symbols, dialogue, responding to particular situations, extempore speech.

Section-B

4. **Reading**: Comprehension of technical & non-technical materials-skimming, scanning, inferring & responding to context.

5. **Technical Writing**: Paragraph & composition writing on scientific & other themes, report writing, research paper writing, library references.
6. **Professional communication**: Business letter, job application, memos, quotations, tender notice.

Books Recommended:

	Authors' name	Title
1.	J. Thomson & A. V. Martinet	A Practical English Grammar
2.	John M. Lennon	Technical Writing
3.	A. Ashley	Oxford Handbook of Commercial Correspondence
4.	J. Swales	Writing Scientific English
5.	Robert J. Dixson	Complete Course in English
6.	Rajendra Pal & J. S. Korlahalli	Essentials of Business Communications

MSE1112 Qualitative and Quantitative Analysis of Materials (Lab)

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Acid-base titration, Oxidation-reduction titration, Precipitation titration, Complex metric titration and Gravimetric titration.
2. Determination of calcium in calcium carbonate.
3. Estimation of zinc and cupper form analysis of brass.
4. Analysis of Portland cement, insoluble silicate, limestone, water and some other industrial products.

Recommended Books:

	Authors' name	Title
1.	A.I. Vogel	A Text-book of Quantitative Inorganic Analysis

CHEM1112 Physical Chemistry Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Determination of cell constant of a conductivity cell.
2. Conductometric titration.
3. Potentiometric titration.
4. Conductometric determination of degree of dissociation.
5. Construction of some electrodes and measurement of their standard potentials.
6. Determination of adsorptive power of an absorbent and verification Langmuir Isotherm.
7. Determination of heat of capacity, heat of solution, heat of neutralization, equilibrium constant and energy of activation.
8. Determination of radius of a molecule by viscosity measurement.
9. Determination of the density of a solid and a liquid.
10. Determination of the coefficient of viscosity of a liquid.

Recommended Books:

	Authors' name	Title
1.	W.J. Popiel	Laboratory Manual of Physical Chemistry
2.	J.B. Yadav	Advanced Practical Physical Chemistry
3.	D.P. Shoemaker et al	Experiment in Physical Chemistry
4.	A. Findlay	Experimental Physical Chemistry
5.	J.N. Gurtu	Advanced Experimental Chemistry

MSE1122 Mechanical Engineering Workshop (Lab)

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Familiar with engineering tools.
2. Study of grinding and drill machine.
3. Cutting, filling and polishing of solid materials
4. Study of lathe machine and Preparation of Nut, bolt and different solid bodies.

Part-I Examination, 2014
(Even Semester)

MSE1211 Crystallography and Structure of Materials

Full Marks: 100, credits: 4, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 1.0, Lectures: 4 hours/week, Duration of Exam: 4 hours

Section-A

1. **Solid Materials:** Types of solids: crystalline, amorphous and polycrystalline solids. Types of crystalline solids: ionic, covalent, molecular and metallic crystals. Cohesive energy of ionic crystals, lattice energy, Born-Haber cycle, isomorphism, polymorphism, enantiotropy and monotropy.
2. **Crystals and Crystal Structures:** The nature of crystalline states, faces, edges and interfacial angle, space lattice, unit cells and patterns, periodicity in crystals. Atomic packing: hcp and ccp structures. Construction of crystals: closed packed hexagonal and square layers of atoms, body-centred cubic crystal, and some simple ionic and covalent structures. Selected crystal structures: Pure metals, diamond and graphite, co-ordination in ionic crystals, AB-type compounds, silica, alumina, complex oxides, silicates, crystallinity in polymers.
3. **Representation and Study of Crystals in Projection:** Introduction, representation in two dimensions, stereographic projection and its construction, stereographic projection in small circle, stereographic net, use of stereographic projection in crystallography, gnomonic projection. Two-dimensional symmetry elements, the five-plane lattice. Bravais lattices and crystal systems: the fourteen space (Bravais) lattices, the symmetry of fourteen Bravais lattices.

Section-B

4. **Crystal Symmetry and Reciprocal Lattices:** Point group and crystal structure, symmetry and crystal habit, thirty two crystal classes, centres and inversion axes of symmetry, crystal symmetry and properties, translational symmetry elements, space groups, Bravais lattices, motifs and crystal structures, reciprocal lattice vectors, reciprocal lattice unit cells, geometrical relationships, reciprocal lattice cell for cubic crystal.
5. **Describing Lattice Planes and Directions in Crystals:** Arrangements of ions in crystals, lattice planes, indexing lattice directions and lattice planes, Miller indices and zone axis symbols, Lattice planes in cubic crystals: lattice plane spacing, interplanar distance, ratio of lattice spacing. Miller indices and Laue indices; zones, zone axes and the zone law, the addition rule; indexing in the trigonal and hexagonal systems; transforming miller indices and zone axis symbols.
6. **Imperfections of Atomic Packing in Crystals:** Disordered crystals. Line defects: dislocation types, dislocation theory. Plane defects: large-angle and small-angle boundaries, stacking faults and F-centre, colour of crystals, Defects in crystals and their influences on the properties of materials.

Recommended Books:

	Authors' name	Title
1.	N. Kundu and S.K. Jain	Physical Chemistry
2.	C. Hammond	Introduction to Crystallography
3.	R. West	Solid State Chemistry
4.	L. V. Azaroff	Introduction to solids
5.	D. McKie & C. Mckie	Crystalline Solids
6.	A. Windle	A First Course in Crystallography
7.	N.F. Kennon	The Structure in Crystals
8.	Paul Ander and Anthony J Ssa	Principles of Chemistry
9.	C. Kittle	Introduction to Solid State Physics

PHY1221 Applied Electricity and Magnetism

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Electrostatics:** Electric dipole; electric field due to a dipole; dipole on external electric field; Gauss's Law and its applications.
2. **Capacitors:** Parallel plate capacitors with dielectric; dielectrics and Gauss's Law; susceptibility, permeability, and dielectric constant; energy stored in an electric field.
3. **Electric Current:** Electron theory of conductivity; conductor, semiconductors and insulators; superconductors, current and current density; Kirchhoffs Law and its applications.

Section B

4. **Electomagnetic Induction:** Faraday's experiment; Faraday's law; Ampere's law, motional e.m.f.; self and mutual inductance galvanometers-moving coil, ballistic and deadbeat types.
5. **Thermoelectricity:** Thermal e.m.f; Seebeck, Peltier and Thomson Effects; laws of addition of thermal e.m.f., thermoelectric power.
6. **DC and AC Circuits:** D.C. circuits with LR, RC, and LCR in series; A.C. circuits with LR, RC, LC, and LCR in series.

Recommended Books:

	Authors' name	Title
1.	Acharyya	Electricity and Magnetism
2.	Admas & Page	Principles of Electricity
3.	Emran et al.	Text Book of Magnetism and Electricity
4.	Halliday & Resnick	Physics (Part-I & II)
5.	Kip	Fundamentals of Electricity and Magnetism
6.	Huq et al.	Concept of Electricity and Magnetism

MATH1211 Differential and Integral calculus

Full Marks:75, credits:3, [Exam: 70%, Quizzes/Class Tests :20%, Attendance: 10%]
Unit:0.75, Lectures:3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Functions:** Domain, Range, Inverse function and graphs of functions, Limits, Continuity, Indeterminate form.
2. **Ordinary Differentiation**: Differentiability, Differentiation, Successive differentiation and Leibnitz theorem.
3. **a. Expansions of functions**: Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's formulae.
   b. Maximum and minimum of functions of one variable.
4. **a. Partial Differentiation**: Euler's theorem, Tangents and normal.
   b. Asymptotes.

Section-B

5. **Indefinite Integrals**: Method of substitution, Integration by parts, Special trigonometric functions and rational fractions.
6. **Definite Integrals**: Fundamental theorem, General properties, Evaluations of definite integrals and reduction formulas.
7. **Multiple Integrals**: Determination of lengths, Areas and Volumes.

Books Recommended:

Text Books:

	Authors' name	Title
1.	B.C. Das and B.N.Mukherjee	Differential Calculus
2.	B.C.Das and B.N. Mukherjee	Integral Calculus

Reference Books:

	Authors' name	Title
1.	F.Ayres	Calculus
2.	Edwards	Differential Calculus
3.	Williamson	Integral Calculus

4.	Muhammad and Bhattacherjee	Differential Calculus
5.	Muhammad and Bhattacherjee	Integral Calculus

STAT 1211 Statistics for Engineers

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.5, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Analysis of statistical data:** Location, Dispersion and their measures, Skewness, Kurtosis and their measures, Moment and Cumulants and Practical examples.
2. **Probability:** Concept of probability, Sample Space, Events union and Intersection of Events, Probability of events, Loss of probability, Conditional probabilities, Bose Einstein Statistics, Bay's Theorem, Chebysec's Inequality and Practical examples.
3. **Random variables and probability Distribution:** Basic concepts, Discrete and continuous random variables, Density and distributional functions, Mathematical expectation and variance, Joint marginal and conditional density functions, Conditional Expectation and conditional variance, Moments and Cumulant generating functions, Characteristic function, Study of Binomial Poisson, Normal and Bivariate Normal distribution and Practical examples.

Section-B

4. **Linear Regression**: Correlation, Rank correlation. Partial and Multiple correlations Linear Regression for two Variables, Principle of Least Squares Method, Lines of best fit, Residual Analysis and examples.
5. **Test of Significance**: Basic ideas of Null hypothesis, Alternative hypothesis, Type-I error Type-II error level of significance Degree of freedom, Rejection region and Acceptance region. Test of Single mean, Single variance, Two sample means and Variances. Test for 2×2 contingency tables, Independence test and practical examples.

Recommended Books:

Text Books:

	Authors' name	Title
1.	P.G.Hoel.	Introductory Statistics
2.	S.G. Gupta	Fundamentals of Statistics

Reference Books:

	Authors' name	Title
1.	A. J. B. Anderson	Interpreting Data
2.	H. Cramer	The Elements of Probability Theory
3.	D. V. Lindley	Introduction to Probability and Statistics
4.	S. Lipschutz.	Probability
5.	Mosteller, Rourke & Thomas	Probability with Statistical Applications
6.	F. L. Wolf.	Elements of Probability and Statistics
7.	T. H. Wonnacot & R. J. Wonnacot	Introductory Statistics
8.	Yule & M. G. Kendall.	An Introduction to the Theory of Statistic

ECON1211 Economics

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.5, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Basic Concepts of Economics:** Definition and subject matter of Economics; Microeconomics vs macroeconomics; Law of Economics; Central economic problems of every society; Different economic systems; Economics and Engineering.
2. **Theory of Demand, Supply and Consumer Behavior:** Law of Demand; Demand schedule and demand curve; Supply law, Supply schedule and supply curve; Shift in demand and supply; Equilibrium in the market; Elasticity of demand and supply
3. **Production and Costs and Theory of the Firm:** Meaning of production; Factors of production; Concepts of total, average and marginal costs, fixed and variable costs.
4. **Theory of the Firm:** Perfect competition and monopoly; Total, average and marginal revenue of a firm; Average and marginal revenue under perfect competition and monopoly; Firm's Equilibrium; Equilibrium of firm under perfect competition and monopoly.

Section-B

5. **The Input-Output Analysis:** Meaning of input-output analysis; Input-output analysis model; balance equation; coefficient matrix; Determination of final demand vector.
6. **Basic Concepts of Macroeconomics:** Growth; Unemployment; Inflation; Philips Curve, Business cycle; Circular flow of economics; Two, three and four sector economics.
7. **National Income accounting and determination:** Concepts of GNP, GDP and national income; Methods of national income accounting; Problems of national income accounting; Keynesian model of national income determination; The multiplier; Effect of fiscal policy in the Keynesian model.
8. **Budgets of Bangladesh:** The revenue at the capital budget; Income, expenditure of the government; direct and indirect taxes.
9. **Development Planning in Bangladesh:** Need for planning in Bangladesh; Various five year plans in Bangladesh; Development strategies in the five year plans of Bangladesh.

Books Recommended:

	Authors' name	Title
1.	Semuelson and Nordhous	Economics
2.	Byrons and Stone	Economics
3.	Dewett, K. K.	Modern Economic Theory
4.	Ahuja, H. L.	Advanced Economic Theory
5.	Government of Bangladesh	Various Five Year Plans

MSE1212 Crystallography Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Concept of Unit and dimensions.
2. Familiar with different crystal systems.
3. Identification of different crystal structures.
4. Calculation of compactness of different structures.
5. Determination of different phases of materials from diffraction intensity profile.
6. Determination of lattice parameter.

MSE 1222 Engineering Drawing and Graphics Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hour

Experiments:

Introduction to engineering drawing, Concept of projection, First angle and third angle projection, Orthographic drawing, Pictorial drawing: Oblique, isometric and perspective drawing, Introduction to AutoCAD, drawing of two and three dimensional objects.

B. Sc. Engg. Part-II, Odd Semester, Session 2014-2015
Part-II Examination, 2015

MSE2111 Polymeric Materials

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Concept of Polymer:** Introduction and definition of polymer, classification of polymers, nomenclature of polymers, characteristics of different types of polymers. Natural and synthetic polymers; organic, inorganic and organic-inorganic hybrid polymers; simple molecules and macromolecules; inter-molecular forces and chemical bonding in polymers; important uses of polymeric materials; polymer waste disposal and remedies.
2. **Polymer Formation Reactions:** Addition polymerisation, condensation polymerisation, coordination polymerisation, ring opening polymerisation, copolymerisation, degree of polymerisation; mechanism of polymerisation (free radical, cationic and anionic), kinetics of polymerisation.

3. **Specialty Polymers:** Polyelectrolytes, ion containing polymers; conducting polymers, biomedical polymers, thermally stable polymer, thermoplastic, elastomers (TPE), polymer composites, polymers for combating environmental pollution.

Section-B

4. **Characterisation of Polymers:** Nature of polymer molecules in solution, size and shape of macromolecules in solution; molecular weight, number average and weight average molecular weight; molecular weight distribution, isolation and purification, fractionation, determination of molecular weight of polymer, molecular weight distribution cases.
5. **Structure and Rheology of Polymers :** Viscous flow, kinetic theory of rubber elasticity, viscoelasticity; mechanical model of a viscoelastic material, glassy state and glass transition; mechanical properties of crystalline polymers, crystalline melting point, relation between Tm and Tg, properties involving large and small deformation, property requirements and polymer utilization.
6. **Polymer Technology:** Introduction, physical properties, viscous application, plastics, fibres, elastomers, adhesives, polymer additives and compounding; Processing of polymers: Moldings, processing methods, multipolymer systems, polymeric composites and melamine.
7. **Polymer Analysis:** Identification, physical testing (tensile strength, flexural strength, impact strength, share strength); spectral methods, chromatographic methods, identification of typical plastic materials; testing methods - thermal, electrical and chemical.

Recommended Books:

	Authors' name	Title
1.	V. R. Gowariker, N. V. Viswarathan & J. Sreedhar	Polymer Science
2.	P. Bahadur & N. V. Sastry	Principles of Polymer Science
3.	S. L. Rosen	Fundamental Principles of Polymeric Materials
4.	M. G. Aurora & M. Singh	Polymer Chemistry
5.	Premamoy Ghosh	Polymer Science and Technology of Plastics and Rubber

MSE2121 Basic Quantum Mechanics

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.5, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Introduction to Quantum Mechanics:** Shortcomings of classical theory, Basic concept of quantum mechanics – Planck's radiation law, photoelectric effect, Einstein equation,Compton effect, the bohr atom model Measurements and observable, linear operators, Hermitian operator. Eigen value equations – Eigen values and Eigen functions.
2. **Complementary Principle:** Physical postulates of quantum mechanics, Wave function and its interpretation de Broglie wave, wave packets and uncertainty principle, degeneracy, principle of superposition.
3. **Schrödinger Wave Equation:** Time dependent and time independent schrodinger wave equations, Expectation values, Particle in a box, finite potential well, tunnel effect, harmonic oscillator.

Section-B

4. **Quantum Theory of the Hydrogen Atom:** Schrodinger equation for the hydrogen atom, separation of variables, Quantum numbers, Electron probability density, Radiative Transitions, selection rules, Zee man effect.
5. **Many Electron Atoms:** Electron spin, Exclusion principle, symmetric and ant symmetric wave functions, Atomic structures, spin-orbit coupling, total angular momentum, X-ray spectra.

Recommended Books:

	Authors' name	Title
1.	Arthur Beiser	Concept of Modern Physics
2.	Satya Prakash	Advanced quantum mechanics
3.	David J. Griffiths	Introduction to quantum mechanics
4.	R. Shankar	Principles of quantum mechanics

MSE2131 Electronic Properties of Materials

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Atomic Structure:** Introduction, Atomic structure, The Ratherford and Bhor atom model, the single electron system, wave, particle and its duality, Electron states in atoms, X-ray spectra.
2. **Energy Bands in solids:** Introduction, Energy bands in metals, semiconductors and insulators. Energy spectra in atoms, molecules, and solids, The Bloch theorem, The Kronig Perry model, Brillouin zone, Effect of temperature & Pressure on energy band gap.
3. **Electrons in a crystal:** Fermi energy & Fermi surface, Fermi Distribution Function, Density of states, Population density; complete density of states function within a band, consequences of the band model, Effective mass.

Section-B

4. **Properties of semiconductor:** Introduction, The Intrinsic and Extrinsic Semiconductors, Charge carriers in semiconductors, carrier concentration for intrinsic & extrinsic semiconductors Fermi Energy level in intrinsic & extrinsic semiconductors, Conduction in semiconductors, Effect of temperature on conduction, Ionization Energy and its Calculation, Band tail, Charge Compensation in semiconductors.
5. **Carrier Transport Phenomena:** Drift velocity, Drift current density, Mobility Effects, Conductivity, Velocity Saturation, Carrier Diffusion, Diffusion Current Density, Total Current Density, Graded Impurity Distribution, Induced Electric field, The Einstein Relation, Thermoelectric effect, Hall Effect, Seebect effect and Magneto-resistance.
6. **Electron Scattering in semiconductors:** Introduction, Mattheisen's rule, types of scattering, phonons scattering, impurity scattering, ionic scattering and dislocation scattering.

Recommended Books:

	Authors' name	Title
1.	Donald A. Neamen	Semiconductor Physics & Devices
2.	Rolf E. Hummel	Electronic Properties of Materials
3.	H. C. Gupta	Solid State Physics
4.	M. Ali Omar	Elementary Solid State Physics
5.	K. J. Pascoe	Properties of Engineering Materials
6.	P. Bhattacharya	Semiconductor Optoelectronic Devices

MATH2111 Matrices and Differential Equations

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Algebra of Matrices:** Adjoint, Inverse and rank of matrix-definition, Properties and evaluation.
2. **Elementary Transformations:** Echelon: Canonical and normal forms, Solution of system of linear equations, Consistency and solution of homogeneous and nonhomogeneous systems by matrix method, and reduction to equivalent system.
3. **Characteristic Equation**: Eigenvalues, Eigenvectors and Caley-Hamilton theorem, similar matrices and diagonalization.

Section-B

4. **Solutions** of first order and first degree and first-order and higher degree equations with variable coefficients.
5. **Solution of Higher-Order** linear differential equations.
6. **Differential Equations**: Series solution of linear differential equation, Series solution of second order equation with variable coefficients, Solutions of partial differential equation, Laplace's equation and transformation, Poisson's equation, Helmholtz's equation, Diffusion equation, Green's function solution, Integral equation.

Recommended Books:

	Authors' name	Title
1.	M. L. Khanna	Matrices
2.	S. L. Ross	Introduction of Ordinary Differential Equations
3.	F. Ayres	Theory and problems of Matrices

4.	Moduffe	Theory of Matrices
5.	F. Ayres	Differential Equations
6.	B. D. Sharma	Differential Equations
7.	L. Pipes	App. Mathe. For Engineers and Physicist
8.	I. S. Sokolnikoff & R. M. Redheffer	Math. For Physics and Modern Physics

PHY2111 Basic Electronics and Instrumentations

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Semiconductor Diodes:** n-and p-type semiconductors, p-n junction diodes and their volt- ampere characteristics, Zener diode, half-and full wave rectifiers, voltage regulation using Zener diodes.
2. **Bipolar Junction Transistors**: PNP and NPN Transistors: Construction and Operations, DC characteristics of CE, CB and CC configurations and transistor amplifiers in different configuration.
3. **Feedback and Oscillators:** Principles of feedback, positive and negative feedback, oscillators: RC, Hartely and Colpitt's oscillator.

Section-B

4. **a) Number Systems**: Decimal, Binary, Octal and Binary codes.
   b) Logic Gates and Boolean algebra: Logic gates: OR, AND, NOT, NOR, NAND, Ex-OR and Ex-NOR operations and their truth tables; Laws of Boolean algebra, De-Morgan's theorems.
5. **Flip-Flops**: RS, D, T and JK Flip-Flops.
6. **Instrumentations**: Oscilloscope, pH-meter, Spectrophotometer, GM and Scintillation counters; Concept of computer on-line measurements.

Books Recommended:

	Authors' name	Title
1.	Grob, B.	Basic Electronics
2.	Gupta, SL and Kumar, V.	Handbook of Electronics
3.	Boylestad, RL and Nashelsky, L.	Electronic Devices and Circuit Theory
4.	Mehta, VK.	Principles of Electronics
5.	Malvino, AP	Electronic Principles
6.	Tocci, RJ.	Digital Systems
7.	Souhney, AK	A Course in Electrical Measurements & Electronics

ACCO2111 Industrial Management & Accountancy

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.5, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Industry:** Commerce-Industry: Meaning & Characteristics of Industry, Types of Industry; Business: Meaning & Objectives of Business, Types of Business: Sole Proprietorship, Partnership, Joint Stock Company, State Enterprise and Cooperative Society.
2. **Fundamentals of Management**: Meaning of Management, Principles of Management, Functions of Management, Levels of Management, Roles of Management, Scientific Management and Core Management skills.
3. **Factory Location and Plant Layout**: Factors Determining Location of Factory, Steps in Location, Factors Influencing Layout, Types of Layout, Problems of Layout.
4. **Work-Environment and Plant Utility**: Meaning, Importance, Factors Affecting Work Environment, Plant Utility, Lighting, Ventilation, Air-conditioning, Sanitation and Noise Control.
5. **Sole Proprietorships**: Features, Advantages, Disadvantages of Sole Proprietorship, Sustainability of Sole proprietorships.
6. **Man Power Planning & Motivation**: Need, Objectives, Manpower Planning Process, Recruitment, Selection and Training, Issue in Managing People, Maslow's Need Hierarchy, Social Needs and Productivity, Hygiene and Motivators.
7. **Conflict & Union Management Perspective**: Meaning, Process of Conflict, Types of Conflict, Industrial Conflict Resolution Methods, Negotiation Skills, Growth of Trade Unions, Functions, Structure, Leadership and Management in the Trade Union, Collective Bargaining.

Section-B

8. **Accountings**: History, Scope and Nature of Accounting, Purpose of Accounting, Information and Uses.
9. **Transaction**: Meaning and Features, Accounting Equation, Meaning and Classification of Account, Double entry System, Rules for Determining Debit and Credit, Accounting cycle.
10. **Journal, Ledger and Trial Balance**: Meaning, Features, Necessity, Rules, Double and Triple Column Cash Book and Practical Problems.
11. **Work Sheet**: Meaning, Purpose, Adjustment Entries and 10 Columns Work Sheet.
12. **Cost Terms Concepts and Classification**: Meaning of Cost, Manufacturing and Non Manufacturing Costs, Period and Product Costs, Variable and Fixed Costs, Direct and Indirect Costs, Differential, Opportunity and Sunk Costs, Schedule of Cost of Goods Manufactured, Schedule of Cost of Goods Sold and Income Statement.
13. **Cost-Volume-Profit Relationship:** Contribution Margin and Ratio, Break-even Analysis, CVP relationship in Graphical Form and Target Net Profit Analysis.

Books Recommended:

	Authors' name	Title
1.	M. C. Shukla	Business Organization and Management
2.	Harold Koontz and Heinz Weihrich	Management
3.	Krajewski and Ritzman	Operation Management
4.	David A. Decenzo and Stephen P. Robbins	Human Resource Management
5.	Afzal A. Rahman	Managing Conflict in Organization
6.	Hermanson Etar	Accounting Principles
7.	Ray H. Garrison	Managerial Accounting

MSE2112 Polymer Synthesis and Characterisation Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Preparation of polystyrene by a free radical polymerisation process.
2. Preparation of solid epoxy resin.
3. Determination of epoxide equivalent of the given epoxy resin by the pyridinium chloride method.
4. Preparation of polysulphide rubber (thiokol).
5. Determination of melting point, storing time and gel time of phenolic resins.
6. Determination of molecular weight of polymer by end group analysis and viscometry.
7. Estimation of number average molecular weight by hydroxyl end group analysis.
8. Identification of different rubbers and plastics.
9. Determination of tensile strength/breaking strength, elongation of synthetic natural fibres, fabrics and composite materials.

Recommended Books:

	Authors' name	Title
1.	A.I. Vogel	A Text Book of Quantitative Inorganic Analysis
2.	G.D. Cheistain	Analytical Chemistry
3.	F.J. Welcher (edited)	Standard Methods of Chemical Analysis
4.	G. W. Ewing	Instrumental Methods of Chemical Analysis
5.	P. Bahadur & N. V. Sastr	Principles of Polymer Science

PHY2112 General Physics Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Determination of the viscosity of a liquid.
2. Determination of the surface tension.
3. Determination of the galvanic resistance (half deflection method).
4. Determination of the figure of merits.
5. Measurement of high resistance.
6. Measurement of low resistance by the method of fall of potential.

7. Determination of end-correction of a metre bridge wire.
8. Measurement of resistance per unit length of a metre bridge wire.
9. Determination of the specific resistance of a wire.
10. Calibration of a metre bridge wire.
11. To study the variation of reactance due to L and C with frequency.
12. Determination of resonance frequency in LCR circuit (series and parallel).
13. To study the characteristics of p-n junction diode.

Part-II Examination, 2015
(Even Semester)

MSE2211 Materials Thermodynamics and Kinetics

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Introduction:** Scope of thermodynamics; Thermodynamics systems and equilibrium; zeroth law; Thermodynamics process; Internal energy; Equations of state.
2. **First law of thermodynamics:** Statement of first law of thermodynamics; Thermodynamics cycles; Work in difference process; Isothermal and adiabatic equation; Concept of enthalpy.
3. **Second and Third laws of thermodynamics:** Statement of second law; Carnot's cycle and Carnot's theorem; Heat engine; Concept of entropy ; Principle of increase of entropy; Changes of entropy in reversible and irreversible process; Entropy temperature diagram, Third law of thermodynamics.

Section-B

4. **Thermodynamics relation:** Thermodynamics potential functions; The Maxwell's relations; Joule – Thomson effect; Chemical potential; Phase equation and phase rule; Phase transitions.
5. **Thermodynamics in materials:** The effect of temperature on metal crystals; The specific heat curve and transformations; Heat content and free energy; Free energy of transformation; The variation of free energy with temperature and polymorphism; Thermodynamics of lattice defects; The mechanism of phase changes; Thermo dynamical Statistics.

Recommended Books:

	Authors' name	Title
1.	T. Hossain	Text book of heat
2.	Brizlal	Heat and Thermodynamics
3.	R. E. Smallman	Modern Physical metallurgy

MSE2221 Materials for Energy Conversion and Storage

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Sources of Energy:** Introduction, Type of energy Sources, Conventional and Non-Conventional Energy, Energy storage and Conversion.
2. **Electro-chemical Cells:**
   a)Primary Cells; Leclanche cell - construction, shelf-life, cell reactions & performance; flat type dry Leclanche cell; magnesium dry cell; air-depolarised cell; various oxide-depolarised cells; chloride-depolarised cells**.**
   b)Secondary Cells: General considerations; lead-acid accumulator – construction, capacity, efficiency, cell reactions; alkaline cells – construction, cell reactions, capacity, efficiency; silver-zinc accumulator – construction, cell reactions & performances.
3. **Fundamentals of Fuel Cells:** Direct and indirect energy conversion; fuel cells and related systems; air-depolarised fuel cells, electrode processes; choice of cell reactions; thermodynamic efficiency of fuel cells; electromotive force of fuel cells; rates of electrode processes. Temperature dependent Fuel Cells, Application of fuel cell systems and future of the fuel cells.

Section-B

4. **Materials for Solar Energy Conversion:** Introduction, solar radiation; selective surface for solar energy conversion, characteristics of surface, types of solar selective materials, Solar reflector materials, anti-reflection materials, preparation of selective black surface, production methods of coatings.
5. **Photovoltaic System:** Introduction, Photovoltaic devices, Semiconductor pn junction principles, types of solar cells, solar cell construction, Solar cell modules, Storage batteries, design of photovoltaic systems.
6. **Bioconversion and Biomass:** Introduction, Photosynthesis, Biogas Generation, Digester and their Designs, Materials for Biogas and Biomass and Their application.

Recommended Books:

	Authors' name	Title
1.	E. C. Potter	Electrochemistry
2.	G. W. Vinal	Storage Batteries
3.	A. McDougall	Fuel Cells
4.	K. R. Williams	An Introduction to Fuel Cells
5.	B. L. Theraja	Basic Electronics Solid State
6.	C. D. Rai	Solar Energy Utilization
7.	D. Rapp	Solar Energy

MSE2231 Fundamentals of Electrical Engineering

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Circuit Models**: Characteristics and applications of linear circuit elements; Ideal and non-ideal voltage and current source; Series, parallel and compound circuit analysis; Loading effects; Voltage sources in series and parallel, open and short circuit.
2. **Circuit Theorem and Network Analysis**: Voltage and current divider rule; Kirchhoff's law; Superposition; Thevenin's, Norton's and Maximum power transfer theorem; Reciprocity theorem; Mesh and Nodal analysis; Delta-star transformation.
3. **A.C. Theory and Frequency Domain Analysis:** General AC theory, AC power, average and RMS value of AC voltage and current, uses of complex quantities in AC circuit, resonance phenomena in circuits, Q-value and bandwidth.

Section-B

4. **Transformer**: Working principle of transformer, elementary theory of an ideal transformer-E.M.F., equation of transformer-voltage transformation ratio, transformer with loses but no magnetic loss, transformer on load-transformer on no load, transformer with resistance and leakage resistance-simplified diagram, transformer rating in KVA, condition for maximum efficiency, classification and testing of transformer.
5. **D.C Machines:** D.C generator; principle, types, performances and characteristics, D.C motor; principles, Types of motor, performances, speed control, starters and characteristics.
6. **A.C Machines:** Classification of A.C motors, single phase induction motor principle, equivalent circuit of an induction motor, introduction of synchronous and special type of motor.

Recommended Books:

	Authors' name	Title
1.	D. R. Resnick and D. Halliday	Physics, Part-2
2.	B. L. Theraza	Electrical technology (Volume-1&2)
3.	Robert L. Boylestad	Introductory Circuit Analysis
4.	R. P. Ward	Basic Electrical Engineering
5.	Stephen J. Chapman	Electrical Machinery Fundamentals
6.	George F. Corcoran	Alternating Current Circuits

CSE2241Computer Fundamentals and Programming in C & C++

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Introduction:** Classification of Computer, working features of computer system, application.
2. **Hardware:** Organization and architecture of a computer, CPU, memory units, I/O devices, peripheral devices, BIOS, bus architecture, storage devices.
3. **Software and Internet Fundamental:** Classification, system software, application software, operating system concepts, word-word processing, spreadsheet database and presentation software, internet service, e-mail, e-commerce, different types of network, network topologies, communication media.

Section-B

4. **Programming Basics:** Different types of computer language, structured and unstructured programming, algorithms and flowcharts, Overview of C programming languages; C program structure, compiler, interpreter, C tokens, keywords, identifiers, data types, constants, variables.
5. **Operation and Expressions:** Classification of operators, statements, conditional statements, if and loops; for, while and do-while, decision making and branching, function arrays, pointer, file reading and writing operation in C.
6. **Object Oriented programming:** Introduction, C++ terminology, encapsulation, class hierarchy, operator overloading, function overloading, C++ I/O function.

Recommended Books:

	Authors' name	Title
1.	Peter Norton's	Introduction to Computers
2.	Taylor L. Booth	Introduction to computer Engineering Hardware and Software Design
3.	E. Balagurusamy	Programming in ANSI C
4.	Merbert Schildt	The complete Reference C & C++
5.	Debasish Jana	C++ and object Oriented Programming Paradigm

CHEM2211 Organic Chemistry

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures:2 hours/week, Duration of Exam: 3 hours

Section-A

1. **General Concept (3 lectures):** a) Purity criteria & purification of organic compounds, detection of elements in organic compounds. b) Bonding: Covalent bond (σ and π bond) formation in organic compounds, hybridization of orbitals, (sp, sp^2 and sp^3).
2. **Aliphatic (6 lectures):** Nomenclature, preparation, properties, types of reactions and important uses of aliphatic hydrocarbons (alkanes, alkenes, alkynes), and their homologues: alkyl halides, Grignard reagents, alchohols, aldehydes ethers & ketones, carboxylic acids & their derivatives (halides, anhydrides, amides, esters), alkyl amines.
3. **Alicyclic Compounds (3 lectures):** Nomenclature, preparation and reactions of alicyclic compound cyclopropane, cyclobutane, cyclohexane and their derivatives, ring formation and stability. Angle strain; Baeyer strain theory and its weakness, Sachse-Mohr modifications.

Section B

4. **Aromatic compounds (8 lecturs):** a) Structure of benzene (Kekule & resonance structure), aromaticity, mechanism of electrophilic substitution, substitution, orientation and resonance; effects of the substituted groups in the mono-substituted benzene rings (activation & deactivation, orientation). b) Functional derivatives of benzene (chloro, nitro & amino benzene, diazonium salts, phenols). Polynuclear hydrocarbons.
5. **Biochemistry (6 lectures):** Definition & characteristics classification , structures, and reactions of amino acids (isoelectric points), proteins and carbohydrates.
6. **Stereochemistry (7 lectures):** Stereoisomers. Asymmetric carbon atoms and optically active compounds; optical and molecular rotation. R and S configurations, optical and geometrical isomerisms of simple organic compounds.

Recommended Books:

	Authors' name	Title
1.	Morrison & Boyd	Organic Chemistry
2.	I. L. Finar	Organic Chemistry
3.	Bahl & Bahl	Organic Chemistry Vol. I & II
4.	Fieser & Fieser	Organic Chemistry: Advanced Organic Chemistry
5.	E. L. Eliel	Stereochemistry of Carbon Compounds
6.	P. Sykes	A Guide to Mechanism in Organic Chemistry
7.	R. K. Barsal	Organic Reaction Mechanisms
8.	E. S. Gouldganic	Organic Reaction Mechanism

LAW2211 Law and Professional Ethics

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Law:** Principle of law of contract, agency, partnership, sale of goods negotiable instruments, insurance-insolvency.
2. **Company law**: The companies act with special reference to the amendments and ordinances applicable to Bangladesh. Law regarding formation, Incorporation, Management and winding up of companies.
3. **Labor Law**: The scope and sources of labor law, Law in relation to wages, hours, health, safety and other condition to work, The legislation effecting employment in factories, The trade union legislation arbitration, the policy of the state in relation to labor, Elementary principle of labor law.

Section-B

4. **History and Development of Engineering Ethics**: Study of Ethics in Engineering. Applied Ethics in engineering. Human qualities of an engineer. Obligation of an engineer to the clients and to other engineers. Measures to be taken in order to improve the quality of engineering profession.
5. **Ethical Expectations**: Employers and Employees inter-professional relationship, maintaining a commitment of Ethical standards, desired characteristics of a professional code, Institutionalization of Ethical conduct.

Books Recommended:

Text Books:

	Authors' name	Title
1.	K. Sen	A Hand Book of Commercial Law
2.	A. B. Siddique	The Law of Contract
3.	A. A. Khan	Labour and Industrial Law
4.	Emile Durkheim	Professional Ethics and Civics Morals
5.	J. D. Mabboth	An Introduction to Ethics

Reference Books:

	Authors' name	Title
1.	A. G. Maitra	Laws of Contract
2.	Coopers	Outline of Industrial Law
3.	A. Zulfiquar	A Text Book on the Bangladesh Labour Act-2006
4.	P. Narayanan	Intellectual Property Law
5.		The Patent and Design Act, 1911
6.	A. R. Khan	Business Ethics
7.		M. Radar:Ethics and the Auman Community
8.	G. E. Moore	Principia Ethicia

CSE2212Computer Programming and Electrical Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Computer programming and its applications to simple problems solution.
2. Writing and running programs for the solution of Engineering and Mathematical problems.
3. Solution of simple problems using C / C^{++} language.
4. Design and construction of transformer.

CHEM2212 General Chemistry Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Detection of elements in organic compounds.
2. Identification of functional groups organic compounds.
3. Identification of unknown organic compounds by their physical constants such as m.p. and b.p.
4. Preparation of different organic compounds.
5. Separation, purification and characterisation of organic compounds.
6. Determination and identification of different metal ions (Zn, Cu, Fe, Cr, Mn, Mg,Pb,Al, Mg etc).
7. Separation and estimation of iron and calcium, copper and zinc from their mixtures.
8. Analysis of water and some industrial products.

B. Sc. Engg. Part-III, Odd Semester, Session 2015-2016
Part-III Examination, 2016

MSE3111 Phase Diagram and Microstructure of Materials

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Growth of Crystal from Melt and Vapour:** Introduction, Preparation of single crystals by Czochralski, Bridgman and Stockbarger, flux methods; Epitaxial growth and vapour phase transport of single crystal, Electro beam deposition and MBE growth, Preparation of thin films by chemical, electrochemical, vapour deposition, sputtering and spray pyrolysis methods.
2. **Phase Diagrams:** Phase and phase equilibria, Gibbs phase rule, binary isomorphous system - interpretation of phase diagram, determination of compositions & phase amounts, development of microstructure in isomorphous alloys during equilibrium & non-equilibrium cooling, binary eutectic systems – development of microstructure in eutectic alloys, equilibrium diagrams having intermediate phases, eutectoid and peritectic reactions, congruent phase transformations.
3. **Binary Phase Diagrams of Alloy Systems**: Iron-iron carbide phase diagram, development of microstructure in iron-carbon alloys, hypoeutectoid alloys, hypereutectoid alloys, nonequilibrium cooling, the influence of other alloying elements. Phase diagrams for copper-silver, lead-tin, copper-zinc, magnesium-lead, Phase diagrams of ceramic materials.

Section-B

4. **Microstructure of ceramic materials:** Introduction, microstructure of hard porcelain, electrical insulator porcelain, electrical and magnetic ceramics, cement: portland cement clinker, concrete, cermets: metal-ceramic compositions: (a) 96 WC-6 Co (b) 70 TiC-30 Ni (c) 30 Al_20_3-70 Cr and microstructure of refractory materials.
5. **Chemical and Geometrical Structure of Polymers:** General remarks on polymer microstructure based on chemical and geometrical structure, configuration and conformation of monomer unit, stereo-regular polymers-isotactic, syndiotactic and atactic or heterotactic polymers, optically active polymers.
6. **Structural Regular and Irregular Polymers and their Properties**: Amorphous and crystallize polymers, degree of crystallisability, crystallisability, structural regularity and crystallisability, factors affecting on crystallisability of polymers, polymer single crystals, importance of amorphous and crystalline behaviour in same polymeric materials.

Recommended Books:

	Authors' name	Title
1.	William D. Callister	Materials Science & Engg.–An Introduction
2.	William F. Smith	Foundation of Materials Science & Engg
3.	R. E. Smallman & R. J. Bishop	Metals and Materials
4.	W. D. Kingery et al.	Introduction to Ceramics
5.	V. R. Gowariker et al.	Polymer Science
6.	S. Radhakrisna & A. K. Arof	Polymeric Materials
7.	J. C. Anderson et al.	Materials Science
8.	Budnikov	The technology of ceramics and refractories

MSE3121 Glass and Ceramics

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Glass Technology: Glasses:** Definition, structure, composition and constitution, of glasses; Properties of glass: forming methods for glasses, chemical durability, stress release and annealing, glass-metal seals.
2. **Manufacturing and Characterization of Glass:** Raw materials and melting, primary forming operation, finishing operations, manufacturing tolerances and glass design, characterization: by IR, by NMR and by XRD.
3. **Application of Glasses:** Glass containers, flat glass and glazing, laboratory glassware and thermometers, glasses in the chemical industry, sight and gage glasses, electric lamps and electron tubes, illumination.
4. **Fibrous Glass:** Composition and properties of fibre, manufacturing processes and products, application of fibrous-glass wool, applications of fibrous-glass textile products, fibrous-glass-reinforced plastics, metallic glass and crystal glass.

Section-B

5. **General Concept and Structure of Ceramics:** History, Definitions: traditional and engineering ceramics, types of ceramics; AX-type crystal structures, A_mX_p-type crystal structures, $A_mB_nX_p$-type crystal structures, crystal structures from the close packing of anions, ceramics density computations, imperfections in ceramics. Silicate Ceramics: Silica, silica glasses, silicates, layered silicates, diamond, graphite and fullerences. Al_2O_3-Cr_2O_3, MgO-Al_2O_3, ZrO_2-CaO and SiO_2-Al_2O_3 systems, phase composition versus temperature.
6. **Raw materials of ceramics and Clays:** General consideration ,Clay minerals, Talc and related minerals, Silica and silicate minerals, Other raw materials, The role of various kinds ceramic material to the ceramic ware. Composition and plasticity of clays, burning of clays, colour of clay products, brick making methods, efflorescence on bricks, terra-cotta ware, and sanitary ware.
7. **Processing and Characterization of Ceramics:** Material preparations, powder pressing, extrusion, soft plastic forming, slip casting, drying, firing, glass forming methods, ceramic strain sorting, polishing, glazing, decorating, coating of the ware and special processes of ceramics, characterization: by XRD, IR analysis and Impedance measurement.
8. **Refractory Materials:** Fire clay, high alumina refractories, silica, magnesite and magnesia, chrome refractories, fosterite, dolomite, mortar materials, pyrometric cones, chemical reactions of refractories, physical behaviour of refractories, thermal conductivity and specific heat of refractories.

Recommended Books:

	Authors' name	Title
1.	E.B. Shand	Glass Engineering Handbook
2.	William F. Smith	Foundation of Materials Science & Engineering.
3.	William D. Callister	Materials Science & Engineering–An Introduction
4.	J.C. Anderson, K.D. Leaver, D. Rawlings & J.M. Alexander	Materials Science
5.	Robert B. Leighou	Chemistry of Engineering Materials
6.	W.D. Kingery, H.K. Bowen & R. D. Whlmann	Introduction to Ceramics
7.	P. William Lee	Ceramics

MSE3131 Composite Materials

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **General Concepts:** Introduction, types of composite materials, matrix materials, reinforcements, types of fibres, laminar composites, flake composites, filled composites, particulate reinforced composites, cermets, microspheres, solidification of composites, economics of composites and reinforcements.
2. **Design of Composite Materials:** Introduction, hybrid composites, angle-plied composites, mechanics of composites, calculation of properties, unidirectional fibre composites, critical volume fraction, discontinuous fibre composites, rule-of mixtures equation, critical angle.
3. **Carbon-Carbon Composites:** Fabrication, chemical vapours deposition (CVD), properties, interface, graphite, selection of fibre, design woven structure, multi- directional structures, pre-rigidised yarn structures, densification processing, low pressure processing, high pressure processing, properties, applications of carbon-carbon composites.

Section-B

4. **Metal and Ceramic Matrix Composites: :** Reinforcements, matrix selection, matrix-reinforcements interface, fabrication, whisker reinforcements, whisker composite properties, chemical bounding, fibre surface treatment, matrix modification , continuous fibre reinforced composites, chopped fibre composites, fabrication processes, applications of metal and ceramic matrix composites.
5. **Polymer Matrix Composites:** Matrix resins, thermosetting resins, thermoplastic resins, polyaryl ethers (PAE), thermoplastic polyimides (TPI) poly arylene sulfide, molecular composites, fabrication of polymer composites, applications of polymer matrix composites.
6. **Mechanics of Composites:** Bonding mechanisms- adsorption and wetting, inter-diffusion and chemical reaction, electrostatic attraction, mechanical keying, residual stresses; experimental measurement of bond strength; control of bond strength-coupling agents and environmental effects, toughness-reducing coatings, interfacial chemical reaction and diffusion barrier coatings, the interphase region.

Recommended Books:

	Authors' name	Title
1.	D. Hull & T.W. Clyne	An Introduction to Composite Materials
2.	S.C. Sharma	Composite Materials
3.	T.W. Clyne & P.J. Withers	An Introduction to Metal Matrix Composites
4.	K.K. Chawla	Ceramic Matrix Composites
5.	G. Lubin	Hand Book of Composites

MSE3141 Mechanical Behaviour of Materials

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Elastic Properties of Engineering Materials**: Introduction; Mechanical properties: Elasticity, Plasticity, Toughness Resilience, Tensile Strength, Ductility, Malleability, Brittleness, Hardness, Fatigue, Creep; Stress Strain Relation; Destructive and non-destructive testing; Brinell, Vickers and micro-hardness test.
2. **Dislocations in Crystals:** Dislocations in crystals, Edge and Screw dislocations, The mechanism of slip and climb, Imperfect dislocations, Dislocation mobility, The interaction of Solute atoms with dislocations. Dislocations in close packed crystals, (Extended dislocations, Sessile dislocations) Dislocations in hexagonal structure, bcc and fcc lattice, Dislocation in ordered structure.
3. **Deformation of metals and alloys:** Introduction, Elastic and plastic deformation, Deformation in single and polycrystalline materials, Deformation by slip, Deformation by twining, The effect of impurities on twinning, the effect of restrain on twinning.

Section-B

4. **Creep:** Introduction, Creep mechanisms (Transient creep, Steady State Creep, Creep due to grain boundaries, Tertiary creep and fracture.) Metallurgical factors affecting creep. Super plasticity.
5. **Fatigue:** Introduction, Engineering Consideration of fatigue, Metallurgical factors affecting fatigue, The structure charges accompanying Fatigue, The formation of fatigue cracks and fatigue failure, fatigue at cleaved temperatures.

6. **Fracture:** Introduction, Griffith micro crack criterion, The mechanism of fracture, facture affection brittleness, Fracture toughness, Inter granular fracture Ductile fracture, Fracture at cleaved temperature, Fracture mechanism maps, Twinning fracture.

Recommended Books:

	Authors' name	Title
1.	R. E. Smallman	Modern Physical Metallurgy
2.	G. K. Narula, K. S. Narula, V. K Gupta	Materials Science
3.	O. P. Khanna	Materials Science and Metallurgy

MSE3151 Production Metallurgy

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Unit Operations and Unit Processes:** Isolation and separation techniques, equipments, diagrams and applications. Different types of unit processes.
2. **Sources of Metals and Ore Preparation:** Ore deposits, mining, ores, iron ores, aluminium ores, copper ores, lead ores, zinc ores, precious metal ores and other metals ores, physical methods of ore preparation, concentration processes, thermal methods of ore preparation.
3. **General Methods of Metal Production:** Pyro-metallurgical techniques, physical chemistry of thermal reaction processes, hydrometallurgical extraction, thermo-electric extraction, metal refining techniques, theoretical consideration of electrochemical processes.

Section-B

4. **Production of Iron and Steel:** Blast furnace production of pig iron, production of steel-cement and crucible steel, Bessemer process, open-hearth process, steel making in electric furnace, duplex steel making process, production of steel ingots.
5. **Production of Non-ferrous Metals and Alloys:** Non-ferrous metals:Production of Copper, Zinc, Lead, Tin, Nickel and Magnesium. Non-ferrous Alloys: Types of phase equilibria in alloy system, Copper and Zinc alloys, Aluminium alloys, Nickel alloys, Magnesium and Titanium alloys, bearing metals, solders and brazing alloys, die-casting alloys, low-melting alloys
6. **Hydrometallurgical Production of Metals:** Introduction, Production of zinc, gold, silver and uranium.

Recommended Books:

	Authors' name	Title
1.	A.R. Baily	A Text Book of Metallurgy
2.	J. Newton	Extractive Metallurgy
3.	R.B. Leighou	Chemistry of Engineering Metals
4.	Bodsworth	Physical Chemistry of Iron and Steel Making
5.	Rhines	Phase Diagrams in Metallurgy
6.	Brick & Philips	Structure and Properties of Alloys

MSE3112 Glass and Ceramic Processing Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Fabrication of glass, Ceramics and refractory materials
2. Characterization of glass and ceramics by XRD, IR analysis and Impedance measurement
3. Microstructure analysis of glass and ceramics

MSE3122 Mechanical Property Testing Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Determination of tensile and compressive properties of metallic and composite materials.
2. Determination of Hardness, Compression, Impact and Fatigue properties of materials.
3. Analysis of wear and creep damage on common metals and alloys.

MSE3132 Metallography and Microstructure Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Selection and preparation of micro, and macro-specimens.
2. Microstudy of common ferrous, non-ferrous metals and alloys.
3. Microstudy of plain carbon steels and cast irons.
4. Determination of micro-hardness of different phases.
5. Study of microstructure of martensite and annealed steel.
6. Microstructure of composite materials.
7. Quantitative metallography: grain size, volume fraction, aspect ratio, particle size distribution, etc.

Part-III Examination, 2016
(Even Semester)

MSE3211 Physical Metallurgy

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Steel and Tool Steels:** Introduction, Alloy steel, Effect of alloying elements, Nickel, Chromium Nickel-Chromium, Manganese, Molybdenum, Tungsten and Silicon steel, Tool steels; Classification of tool steel, Properties of different tool steel, Cast Iron:;Type of cast iron, White cast iron, Malleable cast iron, Gray cast iron, Alloy cast iron.
2. **Stainless Steel**: Introduction, Martesitic, Ferritic and Austenitic stainless steel, Ni and Cr equivalent, Schaeffler diagram of Stainless steel and Supperalloys.
3. **Heat Treatment of Steel:** Full annealing, spherodising, normalizing, Isothermal transformation diagram, transformation to pearlite and Bainite, cooling curves and the I–T diagram, transformation on continuous cooling, homogeneity of austenite, mechanisms of heat removal during quenching, tempering, austempering.

Section-B

4. **Hardening of Steels:** Precipitation from supersaturated solid solution, changes in properties accompanying precipitation, structural changes, some common precipitation systems, mechanisms of hardening, factors affecting ageing process, duplex ageing, particle coarsening, dispersion hardened alloys. , work hardening, preferred orientation, texture hardening, Case hardening: Carburising, Nitriding, Induction heating and flame heating.
5. **Powder Metallurgy:** Definition and concept, History, Powder metallurgy process, Preparation of metal powder, Characteristics of metal powder, Blending and mixing of powder, Compacting, and Sintering, Hot pressing, Supplemental operation, Design PM parts, Application of Powder Metallurgy.
6. **Metallurgy of Mechanical Working:** Plasticity, Strain hardening, Hot working and cold working, Effects of cold work, Combination of cold working and precipitation hardening, Characteristics of cold rolled sheet, Factors in design parts for cold press forming, Effects of hot work, Factors in design of forged parts, Defects in wrought products, Wrought products vs. castings.

Recommended Books:

	Authors' name	Title
1.	R.E. Smallman	Modern Physical Metallurgy
2.	Sidney H. Avner	Introduction to Physical Metallurgy
3.	Robert B. Leighou	Chemistry of Engineering Materials
4.	Rajendra Kumar	Physical Metallurgy of Iron and Steel
5.	R.E. Reed-Hill	Physical Metallurgy Principles
6.	J.F. Lancaster	Metallurgy of Welding, Brazing and Solderin
7.	Donald S. Clark and Wilber R. Varney	Physical Metallurgy for Engineers

MSE3221 Materials Manufacturing Engineering

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Metal-Casting Processes and Equipments**: Introduction, sand casting, shell-mold casting, expandable pattern casting, plaster-mold casting, ceramic mold casting, pressure casting, die casting, centrifugal casting, casting techniques for single crystal components, inspection of castings, foundries and foundry automation.
2. **Forming and Shaping of Plastics and Composite Materials:** Introduction, extrusion, injection molding, blow molding, rotational molding, thermoforming, compression molding, transfer molding, casting, cold forming and solid phase forming, processing elastomers, processing reinforced plastics, processing Metal-Matrix and Ceramic-Matrix composites, manufacturing honeycomb materials, economics of forming and shaping plastics.
3. **Forming and Shaping Ceramics and Glass:** Introduction, shaping ceramics, forming and shaping glass, techniques for treating glass, design consideration.

Section-B

4. **Material-Removal Processes and Machines:** Fundamentals of cutting, cutting-tool materials and cutting fluids, machining process for producing round shapes, machining process for producing various shapes, nontraditional machining processes.
5. **Fabrication of Microelectronic Devices:** Introduction, semiconductor and silicon, crystal growing and wafer preparation, film deposition, oxidation, lithography, etching, diffusion and ion implantation, metallization and testing, bonding and packaging, reliability and yield, printed circuit board.
6. **Computer-Integrated Manufacturing System:** Introduction, manufacturing systems, computer-integrated manufacturing, computer-aided design and engineering, computer-aided manufacturing, computer-aided process planning, computer simulation of manufacturing process and systems, group technology, cellular manufacturing, flexible manufacturing systems, just-in-time production, artificial intelligence, factory of the future.

Recommended Books:

	Authors' name	Title
1.	Kalpakjian	Manufacturing Engineering and Technology
2.	B. W. Niebel, A. B. Draper, R. A. Wysk	Modern Manufacturing Process Engineering
3.	P. N. Rao	Manufacturing Technology
4.	Rajiv Asthana, Ashok Kumar, Nerendra Dahotre	Materials Processing and Manufacturing Science
5.	Peter Beeley	Foundry Technology

MSE3231 Corrosion Science and Engineering

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **General Concepts:** Definition and importance of corrosion; cost of corrosion, corrosion damages, classification of corrosion, future outlook, electrochemical aspects of corrosion, environmental effects, metallurgical and other aspects.
2. **Theory of Corrosion:** Thermodynamic aspects of corrosion - free energy, cell potentials and EMF series, diffusion processes and double layer, pourbaix diagram; electrode kinetics - exchange current density, activation polarisation, concentration polarisation, combined polarisation, mixed-potential theory, mixed electrodes, passivity, mechanisms of the growth and breakdown of passive films.
3. **Corrosion Testing:** Classification, purpose, surface preparation, measuring and weighing, exposure techniques, standard expression for corrosion rate, NACE test methods, linear polarisation, AC impedance, small amplitude cyclic voltammetry, in-vivo corrosion, paint tests, seawater test.

Section-B

4. **Corrosion Forms and Corrosion Under Special Conditions:** Galvanic corrosion, crevice corrosion, pitting, inter-granular corrosion, selective leaching, erosion corrosion, stress corrosion, hydrogen damage, atmospheric corrosion, underground corrosion, marine corrosion, microbial corrosion.
5. **Corrosion Prevention:** Materials selection; alteration of environment, design, cathodic and anodic protection, inhibitors and passivators, metallic coatings, inorganic coatings, organic coatings.

6. **Corrosion in Industries:** High Temperature Corrosion, Corrosion in boiler plants, gas-turbine blades, chemical industries, petroleum, building and fertilizer industries.

Recommended Books:

	Authors' name	Title
1.	Mars G. Fontana	Corrosion Engineering
2.	H. H. Uhlig & R. Revie	Corrosion and Corrosion Control
3.	K. R. Trethewey & J. Chamberlain	Corrosion
4.	U. R. Evans	An Introduction to Metallic Corrosion
5.	E. C. Potter	Electrochemistry

MSE3241 Electrochemical Science and Engineering

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Electrode Processes:** Electrochemical cells and reactions, faradaic and nonfaradaic processes, mass-transfer-controlled reactions, Nernstian reactions.
2. **Potentials and Thermodynamics of Cells:** Basic electrochemical thermodynamics – reversibility, cell emf, emf and concentration, formal potentials; interfacial potential differences, liquid junction potentials, types of liquid junctions, conductance, transference number and mobility, calculation of liquid junction potentials; selective electrodes.
3. **Kinetics of Electrode Reactions:** Electrode reactions, electrode reaction models, the exchange current at equilibrium conditions, current-over potential relationship, reversible behaviour, effects of mass transfer on electrode reactions., Derivation of general mass transfer equation, migration.

Section-B

4. **Electrodeposition of Metals:** Introduction, adhesion, cohesion, continuity and uniformity of electrodeposits, electrodeposition of alloys, plating corrodible metals, mechanism and kinetics of electrodeposits, mode of growth of electrodeposits, deposition of bright metal coatings, nucleation of coatings, growth morphology, internal stresses in electrodeposits, hardness and wear resistance, porosity, metal surface preparation, electrodeposition of metals from non-aqueous electrolytes.
5. **Electrodes and Cell Design for Industrial Processes:** Introduction, lead dioxide anode, magnetite anode, lead alloy anodes, carbon and graphite anodes, noble metal coated anodes, cathodic materials, diaphrams, ionexchange membranes, general ideas of cell design, detailed consideration of cell design.
6. **Electroplating:** Electroplating of Ni, Cr, Cu, Al, Co, brass, bronze, Ni-Cr alloy, Al-Cr alloy and Al-Co alloy, refractory metals; electrodeposition of metals on plastics, design of tools, electrolytes, electrochemical grinding.

Recommended Books:

	Authors' name	Title
1.	A. J. Bard & L. F. Faulkner	Electrochemical Methods
2.	C. M. A. Brett & A. M. O. Brett	Electrochemistry
3.	K. J. Vetter	Electrochemical Kinetics
4.	J. O. M. Bockris & A. K. N. Reddy	Modern Electrochemistry
5.	A. T. Kuhn (edited)	Industrial Electrochemical Processes
6.	E. C. Potter	Electrochemistry
7.	W. Blum & G. B. Hogaboom	Electroplating and Electroforming
8.	F. A. Lowenheim	Modern Electroplating
9.	R. W. Weiner & A. Walmsley	Chromium Plating

MSE3251 Construction Materials

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Building Stones:** Introduction, Classification of Rocks, Common rock forming minerals, Characteristics of good building stones, uses of stones and their selection, Deterioration and preservation of stones, Testing of stones, common building stones, their composition, properties, uses and occurrence, Artificial stones.

2. **Bricks, Tiles, Terra cotta and Other clay products:** Introduction, Bricks, composition of brick earth, properties of good brick earth, analysis of some brick earth, test of clay, brick making, strength of bricks, Quality of good bricks, Fireclay and firebricks, Strength of refractory bricks, colour of bricks, Testing of bricks, Tiles, Terra cotta, porcelain.
3. **Cement, and Concrete:** Introduction, Sources, Properties and uses of lime, classification, properties and uses of cement, Comparison between cement and lime, chemical constituents and functions of ingredients of cement, manufacture of Portland cement, Setting and hardening of cement, testing of Portland cement, storage of cement, Functions, properties and uses of a good building mortar, characteristics, Classification and properties of concrete, Reinforced cement concrete.

Section-B

4. **Wood Seasoning and Preservation:** Wood seasoning methods, relative suitabilities of different seasoning methods, seasoning defects and their prevention, objects and benefits of seasoning; methods of preservative treatments, non-pressure and pressure treatments, preservative materials and their applications, factors affecting penetration and absorption, prospects and problems of wood preservation.
5. **Timber and wood-based Products:** Introduction, definition and characteristics of good timber, advantages and disadvantages of timber, uses, classification and defects in timber, Testing of timber, plywood, laming board, block board, Fiber board and hard boards.
6. **Asphalt, Bitumen and Tar:** Definition, properties, uses, constituents and types of asphalt, Definition, properties, uses and forms of bitumen, Definition, properties, uses and types of tar, pitch, comparison between asphalt, bitumen and tar.

Recomended Books:

	Authors' name	Title
1.	K. P. Roy Chowdhury	Engineering Materials
2.	R. K. Rajput	Engineering Materials
3.	W. H. Brown	Introduction to the Seasoning of Timber
4.	G. M. Hunt	Wood Preservation
5.	F. P. P. Kollman & W. P. Cote	Principles of Wood Preservation Science & Technology

MSE3212Electrochemical and Corrosion Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Electrorefining of metals.
2. Electrodeposition of Ni, Cu, Co and determination of current efficiency.
3. Plating of Sn, brass,brong,and determination of the plating quality by measuring thickness.
4. Determination of corrosion rates of carbon steels, galvanised steel, aluminium and nickel in various aggressive media.
5. Measurement of corrosion rates of base metals galvanically couples with different area ratios of the noble metals.
6. Microstructural study of some corroded specimen.

MSE 3222 Industrial Project (Laboratory)

Full Marks: 50, credits: 2

B. Sc. Engg. Part-IV, Odd Semester, Session 2016-2017
Part-IV Examination, 2017

MSE4111 Microscopic Methods in Materials Characterisation

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Metallurgical Microscopy**: Basic concept of refractive index, dielectric constant, reflectance and transmittance of light in Materials. Introduction to Optical Microscopy, Reflected Light Optical Microscopy.
2. **Scanning Electron Microscopy** (**SEM):** Introduction, Principle of the Method, Method ,SEM Instrumentation, Sample Preparation and their Modification.
3. **Transmission Electron Microscopy (TEM):** Introduction, Principle of the Method, Practical Aspect of the Method, Method Automation, Sample Preparation Preparation and their Modification.

Section-B

4. **Atomic Force Microscopy (AFM):** Introduction, Principle of operation, Atomic force imaging, Biological molecules, Nanscale surface forces, Non-Contact imaging.
5. **Scanning Tunnelling Microscopy (STM):** Introduction, Principles of STM, Practical aspect of STM, Methods of automation, data analysis, sample preparation.
6. **DTA and TGA:** Introduction to thermal analysis, differential thermal analysis: introduction, principles of method, Practical aspect of the method, data analysis, sample preparation, thermo gravimetric analysis (TGA): introduction, principles of method, Practical aspect of the method, data analysis, sample preparation.
7. **Ellipsometry:** Introduction, Principles of the method, Practical aspect of the method, Methods of automation, data analysis, sample preparation.

MSE4121 Plastic and Rubber Technology

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section -A

1. **Plastic Technology and Plastic Materials:** Introduction to plastic technology, classifications, polyethylene, linear low density polyethylene (LLDPE), polypropylene, copolymer of ethylene, polystyrene, acrylic plastics, polyvinyl acetate, polyvinyl chloride, polytetra fluoroethylene (PTFE), plasma polymerisation, polymer powders and coatings, thermosetting plastics, recent trends in adhesive applications, roto moulding.coumarone-indene resins, acetal resins, polyamides, polyimides, polyurethanes, polycarbonates, epoxy resins, cellulose plastics, phenolic resins, amino resins, silicones, additives for plastics.
2. **Processing of Plastics:** Injection moulding, compression moulding, transfer moulding, blow moulding, injection blow and reinforced moulding, extrusion.
3. **Manufacturing of Plastic Products:** Blow moulded HDPE products, polyurethane foam, synthetic shoes and soles, PVC wires and cables, polyester capacitors, plastic bangles, pressure sensitive tapes, PVC pipes and conduits, zip fasteners, nylon watch straps, artificial acrylic teeth, bakelite electrical parts, spectacle frames, vinyl asbestos floor tiles, contact lenses, plastic welding and sealing.

Section -B

4. **Introduction to Rubbers:** Natural rubber, synthetic rubbers, thermoplastic elastomers (TPE), rubber compounding and processing technology, sulphur vulcanisation, non-sulphur vulcanisation, hard rubber, latex technology.
5. **Rubber Manufacturing:** Manufacture of rubber footwear, beltings, hoses, wires and cables, rubber to metal bonded articles, mechanical seals, cellular products, foam articles, latex thread, tyre, and weather resistant rubber.
6. **Identification and Testing of Plastics and Rubbers:** Identification of common plastics and rubbers, physical testing electrical properties, softening temperature tests, melt flow index (MFI), Glass transition, rheology of polymers plasma polymerisation, polymer powders and coatings, thermosetting plastics, recent trends in adhesive applications, roto moulding, X-ray diffraction and microscopy of polymers.

Recommended Books:

	Authors' name	Title
1.	C.M. Blow	Rubber Technology and Manufacture
2.	Hofman	Rubber Technology Hand Book
3.	Frankly	Rubber Processing
4.	R. Chandra & S. Mishra	Rubber and Plastic Technology
5.	Premamoy Ghosh	Polymer Science and Technology of Plastic and Rubbers

MSE4131 Magnetic, Dielectric and Semiconducting Materials

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures:3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Magnetic Materials:** Introduction to Magnetic Materials, Types of Magnetic Materials, Origin of Magnetism, Langevin Equation for Dia- & Para magnetism; Curie law, Quantum Theory of Para magnetism., Conventional Hard Magnetic Materials, High Energy Hard Magnetic Materials, Structure of Ferrites and Garnets, Magnetic Storage, Uses of various Magnetic Materials.
2. **Ferro & Antiferro Magnetic Materials**: Ferromagnetism, , Magnetic domains. Hunds Rules: Weiss Molecular Field and Exchange integral; Magnetic domain & Bloch wall; Antiferromagnetism, Neel's Theory; Two sub lattice Model, Hysteresis.
3. **Dielectric Materials:** Introduction, Types of Dielectric Materials, Dipole Moment, Polarizability, Macroscopic electric field, Local Electric Field, Dielectric constant, clausius Mossotti relation, Debye equations for Dielectric Constant, Dielectric Loss and dielectric breakdown, dispersion and resonance absorption, Screened & Unscreened Coulomb Potentials. Piezoelectric Materials, Pyroelectric Materials, Ferroelectric Materials, Ferroelectric Theory.
4. **Behaviour of dielectrics in A.C field:** Frequency dependent polarizability, complex dielectric constant, dipolar relaxation and dielectric loss.

Section-B

5. **Manufacturing Wafers:** Semiconductor Silicon Preparation, Crystalline materials, Crystal orientation, Crystal growth, Crystal and wafer quality, Wafer preparation, Wafer slicing, Wafer making, Rough polishing, Chemical mechanical polishing (CMP), Backside processing, Double-sided processing, Edge grinding and polishing, Wafer evaluation, Oxidation, Epitaxial layer on silicon wafer.
6. **Oxidation and Basic Patterning:** Silicon dioxide layer uses, Thermal oxidation mechanism, Thermal oxidation methods, Rapid thermal processing (RTP), High-pressure oxidation, Oxidation processes, Post-oxidation evaluation, Anodic oxidation, Thermal nitridation, Overview of the photomasking process, ten step process, Basic photoresisit chemistry, Comparison of positive and negative resists, Photomasking process, Surface preparation, Photoresist spinning, Soft bake.
7. **Integrated Circuit**: Introduction, advantages of miniaturization and current limitations, advantages of silicon, methods of dielectric isolation porous silicon, ion implantation and SIMOX, hetero-epitaxy, recrystallisation techniques, elemental, structural and chemical methods of characterizing device layers on semiconductor substrates.

Recommended Books:

	Authors' name	Title
1.	Callister, WD	Materials Science & Engineering An Introduction
2.	Dekkar, AJ	Solid State Physics
3.	Kittle, C	Introduction to Solid State Physics
4.	Omar, MA	Elementary Solid State Physics
5.	L L Hench & J K West	Principles of Electronic Ceramics
6.	D. A. Neaman	Semiconductor Physics and Devices

MSE4141 Waste Management, Industrial Safety and Environmental Issues

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Wastes and Treatment Process:** Characteristics and types of industrial effluents and wastes; Principles of industrial waste treatment. General methods of treatment; Preliminary, primary, secondary and tertiary

treatment of industrial wastes; Treatment of wastes or effluents with organic and inorganic impurities; Removal of phosphorous and nitrogen from wastewaters; Suspended solids removal; Ultimate disposal.

3. **Hazardous Waste Management:** Origin and amounts of hazardous wastes; Types of hazardous wastes; Biomedical wastes; Hazardous wastes in the geosphere, hydrosphere, atmosphere and biosphere; Management of hazardous wastes; Off side hazardous waste disposal; Codisposal; Security landfill; characteristics of solid waste; Methods of solid waste treatment; Microbiology involved in solid waste disposal; Radioactive waste disposal; Converting radiowaste into solid form and its management; Hazardous substances and health.
4. **Recycling of Wastes:** Construction materials from waste; Utilization of agricultural wastes; Urban wastes and bagasse for electricity; Biomass into rural power; Recycling of metal, glass, concrete, plastic and rubber; Acacia, partied board and silica from rice husk; Jute wastes into paper and board plastic for heat and electricity generation; Paints from potatoes; Wealth from flyash; Converting garbage into fuel, fertilizers and power; Wastewater reuse.
5. **Water and Wastewater treatment:** Water treatment- Introduction, Coagulation, Softening, Reactors, Mixing and Flocculation, Sedimentation, Filtration, Disinfection, Adsorption; Wastewater treatment- wastewater microbiology, characteristics of wastewater, on-site disposal systems, unit operations of pretreatment, primary treatment, unit processes of secondary treatment, disinfection, advanced wastewater treatment, land treatment, sludge treatment, sludge disposal.

Section-B

5. **Air and Water Pollution:** Definition, sources of air pollution, major air pollutant and their effects. Impacts of air pollution, depletion of the ozone layer and its implications, ozone depleting substances (ODS) and their substitutes, recovery and reuse of ODS, destruction technologies for ODS, the Montreal Protocol and its amendments, ozone layer depletion threat to ecosystem, green house effect; water resources, the hydrologic cycle, water pollutants, biochemical oxygen demand, water quality management in Lakes and Reservoirs.
6. **Industrial Hazards and Risk Analysis:** Types of hazard, industrial pollutants in the environment, hazard identification and classification, occupational exposure and control, legislative activities regarding chemical hazards, pollution hazards in chemical industries, loss prevention and risk analysis, preliminary hazard analysis (PHA), hazard evaluation and process safety management, safety symbols, chronic daily intake (CDI), bioconcentration factor (BCF), risk assessment for chloroform in drinking water.
7. **Control of Industrial Hazards:** Industrial plant layout, ventilation and lighting, pressure vessels, safe storage handling and transportation, electrical systems, fire hazards and prevention, controls for health hazards, personal protective devices, laboratory safety, maintenance procedure, emergency procedure and mutual aid, handling and management of chemicals in the BCIC factories.
8. **Current Industrial Environmental Status:** Concept of threshold limit values, sampling procedure, formulation of guidelines and discharge standards of various industries, permit systems for discharge/emissions, environmental management plan (EMP), objectives and components of EMP, matrix of EMP and its implementation, pollution control laws and acts, case studies with few chemical industries.

Recommended Books:

	Authors' name	Title
1.	S. E. Manahan	Hazardous Waste: Chemistry, Toxicology and Treatment
2.	S. E. Manahan	Environmental Chemistry
3.	C. Baird	Environmental Chemistry
4.	B. K. Sharma and H. Kaur	Environmental Chemistry
5.	T. Sawyer and E. Martell	Industrial Environmental Chemistry
6.	J. M. Dallavalle	The Industrial Environment & its Control
7.	E. Jogensen	Industrial Waste Water Management
8.	R. K. Sapru	Environmental Planning & Management
9.	D. Jacob	The Analytical Chemistry of Industrial Poisons, Hazards and Solvents
10.	S. M. Mosters	Introduction to Environmental Engineering and Science
11.	Metcalf and Eddy	Wastewater Engineering

MSE4151 Surface Engineering and Coating

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Surface Phenomena:** Sorption, films of insoluble substances, adsorption by solids from solutions, electrokinetic potential.
2. **Surface Texture and Surface Active Agents:** Fundamentals of surface texture, application of surface active agents in metal technology: special cleaning operations, rust and corrosion inhibition, electroplating, cutting oils, miscellaneous uses, application in the textile and other industries.
3. **Tribology:** Mechanisms of wear – adhesive, abrasive, corrosive, fatigue and fracture wear; surface coating tribology; design for wear prevention, lubrication.

Section-B

4. **Metallic Coatings:** Preparation of metal surfaces for coatings; methods used in applying metallic coatings; hot dipping, electrodeposition, vapour deposition, spraying, cementation, cladding, sputtering, powder coating; zinc coatings; tin coatings; nickel coatings and other metal coatings, electrodeposition on plastics.
5. **Non-Metallic:**
   (a) Inorganic coatings: Vitreous or porcelain enamels, anodised oxide coatings on aluminium; surface conversion or chemical-dip coatings.
   (b) Organic coatings: Introduction, definition, Function, Constituents, Preparation, characteristics, and types of Paints, electrodeposition of paint, Failure of paint; Definition, functions, constituents, characteristics and types of varnishes, process of varnishing; Furniture polish, lacquer and enamels, properties and types of distempers, distempering process.
6. **Environmental Protection:** Change of environment: changing media, use of inhibitors, removal corrosive constituents, alloy design for prevention of oxidation; thermal barrier coating, design of surfaces for protection.

Recommended Books:

	Authors' name	Title
1.	R. B. Leighou	Chemistry of Engineering Materials
2.	N. K. Adam	The Physics and Chemistry of Surfaces
3.	S. Glasstone	Textbook of Physical Chemistry
4.	Schwatz and Perry	Surface Active Agent

MSE4112 Metallurgical Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Volumetric, spectrophotometric, atomic absorption spectrophotometric and flame photometric techniques in metallurgical analyses.
2. Analyses of commercially available cast iron, different types of steel and stainless steel, different types of bronze (gun-metal, phosphor bronze, Al bronze, Mn bronze), nickel silver, solder and silver alloy.
3. Analyses of available ores, slags and scraps.
4. Analyses of galvanized steel for zinc per unit surface area and determination of layer thickness.

MSE4122 Polymer Processing Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Determination of physical and thermal properties of polymeric materials.
2. Study of microstructure of polymeric materials.
3. Preparation and processing of synthetic polymers.
4. Casting of self supporting polymer films.
5. Synthesis of phenol-formaldehyde resins.
6. Synthesis of vinyl polymers.
7. Synthesis of nylon and polyesters.
8. Analysis and estimation of cellulose, hemicellulose and lignin in a sample of jute fibre and baggage.
9. Analysis and estimation of wood components.

MSE4132 Electronic Materials Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Preparation of semiconducting, magnetic, dielectric and non-linear dielectric bulk materials.
2. Fabrication of semiconducting, magnetic and dielectric thin films by different techniques.
3. Thickness measurement of the samples.
4. Characterisation of semiconducting, magnetic and dielectric materials.
5. I-V characteristics of junctions.

Part-IV Examination, 2017
(Even Semester)

MSE4211 Introduction to Nano and Biomaterials

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Nanomaterials:** Introduction, Carbon Fullerenes and Nanotubes, Micro and Mesoporous materials, Care-Shell Structures, Organic & Inorganic Hybrids, Intercalation compounds, Nano composites and Nano-grain materials.
2. **Nanostructures Fabricated by physical technique:** Lithography, Nanomanipulation and nanolithography, Soft lithography, Assembly of Nanopartices and Nanowires.
3. **Characterization and properties of nonomaterials:** Structural characterization, Chemical Characterization, Physical Properties of nanomaterials.
4. **Applications of Nanomaterials:** Introduction, Molecular electronics & nanoelectronics, Nanobots, Biologicl applications of nanoparticles, Catalysis by Gold nanoparticles, Quantum well and Quantum dot devices, Nanomechanics, carbon nanotube emitters, photo electrochemical cells, photonic crystals and plasmon waveguides.

Section-B

5. **Concepts of Biomaterials:** Historical evolution of biomaterials, biocompatibility, bioactive materials host response, materials degradation, testing and selections, standards, tissue reactions to implanted materials, chemical substances extracted from plastics, metals etc, and their effects on the body.
6. **Metallic and Ceramic Biomaterials:** Corrosion of implants and materials that are suitable for bone plates etc, titanium casting alloys for femoral implants, alumina ceramics, and hydroxyapatite synthetic bone substitutes.
7. **Polymeric Biomaterials:** Solid polymer - ultra high molecular weight polyethylene (UHMWPE) processing, crystallinity and properties related to wear, UHMWPE for joint, wear mechanisms, support design, effects of debris; fibre materials, porous tapes for surface wound closure; resorbable sutures - copolymers of poly-glycolic acid; foams – open cell polyurethane foams.

Recommended Books:

	Authors' name	Title
1.	M. D. Ventra	Introduction to Nanoscale Science and Technology
2.	Bhat	Introduction to Biomaterials

MSE4221 Spectroscopic Analysis of Materials

Full Marks: 75, credits: 3, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.75, Lectures: 3 hours/week, Duration of Exam: 4 hours

Section-A

1. **Introduction to X-ray Diffraction:** X-rays and their generation, origin and characteristics of x-rays, optical grating and diffraction of light, crystals and diffraction of x-rays, Laue equations, Bragg's law, Methods of diffraction- powder methods, single crystal method, x-ray diffraction experiment, Structure of sodium chloride crystal from X-ray studies.

2. **X-ray Diffraction I:** Diffraction under non-ideal conditions, scattering by an electron, scattering by an atom, scattering by a unit cell, application to powder method, multiplicity factor, Lorentz factor, absorption factor, temperature factor, intensities of powder pattern. X-ray optics, counters, pulse-height analysis, special kinds of diffractometry, scalars, rate meters, and monochromatic operation.
3. **X-ray Diffraction II:** Orientation and quality of single crystals structure of poly crystalline aggregates, determination of crystal structure, precise parameter measurements, phase-diagram determination, order-disorder transformations and chemical analysis by X-ray diffraction.

Section-B

4. **Spectroscopic Analysis:** Theoretical principles for visible, UV-visible, microwave, IR, Raman and NMR spectroscopy; instrumentation and their measurement principles; application of spectroscopic techniques for qualitative and quantitative analyses.
5. **Electron Spectroscopy for Chemical Analysis (ESCA):** Theoretical aspects, instrumentation, chemical shifts, factors related to the use of ESCA for surface analysis, application of ESCA to surface studies.
6. **Auger Electron Spectroscopy:** Introduction, the Auger process, the secondary electron energy distribution, experimental apparatus, data interpretation and surface analysis, special problems, some recent developments, some related spectroscopic techniques.
7. **Atomic Absorption Spectrophotometry:** Atomisation, graphic furnace atomisers, volatile hydride, sources of radiation, background correction, detection limits, interferences, application of atomic absorption.

Recommended Books:

	Authors' name	Title
1.	P. F. Kane & G. B. Larrabee	Characterization of Solid Surfaces
2.	B. D. Cullit	Elements of X-ray Diffraction
3.	M. H. Loretto	Electron Beam Analysis of Materials
4.	Galen W. Ewing	Instrumental Methods of Chemical Analysis
5.	E. R. Greef, R. Peat, L. M. Peter, D. Pletcher & J. Robinson	Instrumental Methods in Electrochemistry

MSE4231 Welding and Joining Technology

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Introduction:** History and recent advances in welding and joining technology, different types of welding and Joining techniques, Common terms used in welding and Joining, equipments and machines for welding, cutting and Joining, Hazards and safety standards in welding, Joining and allied Processes.
2. **Gas Flame Processes in welding, cutting and Straightening:** Definition and classification of welding, Oxyfuel gas welding, definition and classification of cutting, Oxygen torch cutting, Fuel gases for Oxyfuel gas cutting, Stack metal powder, chemical flux and underwater torch cutting, Flame Straightening.
3. **Arc Processes for welding and cutting:** Basic circuit and mode of metal transfer for arc welding, different types of arc welding and cutting, power sources for arc welding, metallurgical and heat considerations in thermal cutting.

Section-B

4. **Resistance and other welding:** Introduction, Theory of resistance welding, effect of temperature, pressure and current in resistance welding, power supply for resistance welding, Different types of resistance welding processes. Different types of solid-State welding processes, welding of plastics, thermal spray coating or metalizing.
5. **Brazing and Soldering:** Introduction, definition of brazing, nature and strength of brazed Joints, brazing metals, methods of applying braze metal, heating methods used in brazing, Flux and flux removal, post braze operations and inspections, braze welding, definition of soldering, solder metals, soldering fluxes, heating for soldering, engineering materials and their compatibility with soldering, design and strength of soldered Joints, Flux removal and Flux less soldering.
6. **Adhesive bonding and mechanical Fasteners:** Adhesive materials and their properties, Nonstructural and special adhesives, design considerations, Advantages and limitations, Introduction and methods for mechanical fastening, features for mechanical fastening, manufacturing concerns, design and selection in mechanical faster ring.

Recommended Books:

	Authors' name	Title
1.	E. Paul De Garmo , J. T. BlacRonald, A. Kohser	Materials and Processes in manufacturing

MSE424 Engineering Materials

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Introduction to Engineering Materials: T**he selection strategy, motivation for selection, deriving property limits and material indices, material index examples, materials selection case studies.
2. **Materials for Automobile Structures:** The use of steel, the introduction of plastics, aluminium and its alloys, corrosion damage to automobiles, surface treatment of steel for car bodies, future trend in body construction and materials, Exhaust systems.
3. **Materials for Ship Structures:** The ship girder, factors influencing materials selection for ship hulls, materials of construction.

Section -B

4. **Materials for Air Frame:** Principle characteristics of air craft structures, properties requirements of aircraft structures, requirements for high-speed flight, candidate materials for aircraft structures.
5. **Materials for Engine and Power Generation:** Internal combustion engine, external combustion engine, materials for bearing, materials for springs.
6. **Materials for Sports:** The revolution in sports products, the tradition of using wood, tennis rackets, golf clubs, archery bows and arrows, bicycle for sports, fencing foils, materials for snow sports, safety helmets.

Recommended Books:

	Authors' name	Title
1.	Michael F. Ashby	Materials Selection in Mechanical Design
2.	V. B. Bhandari	Design of Machine Elements
3.	V. M. Faires	Design of Machine Elements
4.	E. Alfredo Campo	Selection of Polymeric Materials
5.	F. A. A. Crane, J A Charles and J Furness	Selection and Use of Engineering Materials
6.	R. E Smallman, R. J Bishop	Modern Physical Metallurgy and Materials Engineering
7.	Flake Cambell Jr	Manufacturing Technology for Aerospace Structural Materials

MSE4251 Fibre Technology

Full Marks: 50, credits: 2, [Exam: 70%, Quizzes/Class Tests: 20%, Attendance: 10%]
Unit: 0.50, Lectures: 2 hours/week, Duration of Exam: 3 hours

Section-A

1. **Structure and Properties of Fibres:** Fundamental concepts, classification, orientation and crystallinity of polymers, influence of orientation on fibre properties, stereo regular fibrous polymers, chemical constituents and properties.
2. **Cellulosic Fibres:** Natural history of cotton and jute fibre, chemistry of cellulose, action of physical and chemical agents on cellulose, their preparation for spinning, properties and uses.
3. **Regenerated Man-Made Fibres:** Regenerated cellulose yearn including cupprammonium, viscous and the more highly oriented fibres obtained by stretch spinning, polynosic fibres, preparation of cellulose acetate and spinning fibres from the product, chemically modified cellulosic fibres, production and uses of alignate fibres, casein fibres.

Section-B

4. **Synthetic Fibres:** Nylon, aromatic polyamides, polyureas, polyesters, polyvinyl chloride, polyethelene, glass and carbon fibres, metallic fibres, fibres of the future.
5. **Fibre Processing:** Textured yearn, staple fibres, non-oven fabrics and belts, mercerising, bleaching, dyeing and finishing.
6. **Fiber Reinforced Composites**: Introduction, requirements of a fiber for reinforcement, advantages and disadvantages of jute and other natural fibers for composite reinforcement, lignin and its role, Jute Fiber Reinforced Wooden Boards , Jute Fiber Reinforced composites for automobile industries and for other purposes, Synthetic fiber reinforced composites.

Recommended Books:

	Authors' name	Title
1.	R. W. Monchieff	Man–Made Fibres
2.	J. M. Matthews	Textile Fibres
3.	E. R. Trotman	Dyeing & Chemical Tech. of Textile Fibres
4.	V. R. Gowariker	Polymer Science
5.	F. Sadov, M. Korchagin & A. Matetsky	Chemical Technology of Fibrous Materials

MSE4212 Welding and Joining Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Welding: Metal joints: riveting, grooving, soldering, welding; Welding practice: electric arc steel, aluminium, fabrication of electrode; welding defects: visual, destructive and non-destructive tests of welding.
2. Gas welding and equipment, types of flame, welding of different types of materials. Gas welding defects. Test of gas welding.
3. Hard Coating of Materials by Welding Process.

MSE4222 Computer Aided Engineering Drawing & Designing Laboratory

Full Marks: 50, credits: 2, [Exam: 60%, Quizzes/Class Tests: 30%, Attendance: 10%]
Unit: 0.5, Duration: 6 hours/week, Duration of Exam: 6hours

Experiments:

1. Drawing three dimensional objects.
2. Drawing various types of crystal models.
3. Modelling microstructure of metals, alloys, ceramics and polymers.
4. Construction of materials properties database.
5. Use of an A/D converter for data collection.
6. Construction and fitting of curves, and determination of their slopes.
7. Interfacing a PC for data acquisition and control.
8. Microcomputer architecture.
9. Preparation of presentation slides using power point.
10. Drawing engineering objects using AutoCAD.

Recommended Books:

	Authors' name	Title
1.	R. S. Lowrie	Lattices
2.	S. Tickoo	AutoCAD 2002
3.	D. Harrington *et al.*	Inside AutoCAD 2002
4.	J. A. Leach	AutoCAD 2002 Companion
5.	W. D. Callister	Materials Science & Engg.- An Introduction

MSE4232 Research Project (Laboratory)

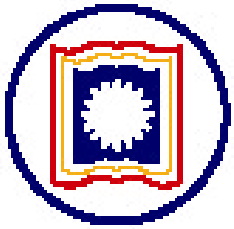
Full Marks: 50, credits: 2

Appendix 1

The Faculty of Engineering is recommending **the Academic Ordinance for B. Sc. Engineering Degree,** Faculty of Engineering, University of Rajshahi.

[Reference: Dean's Letter No-**/Engineering Faculty, Meeting held on June 22, 2013]

Academic Ordinances



Faculty of Engineering
University of Rajshahi

June 22, 2013

[*Approved at the ….th meeting of Academic Council held on.…*.]

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24.6.2013

Faculty of Engineering
University of Rajshahi

Academic Ordinance for Undergraduate Programme
for the Award of the Degree of Bachelor of Science in Engineering

1. Definitions

1.1 'University' means the University of Rajshahi, Bangladesh, abbreviated as RU, Rajshahi.
1.2 'Syndicate' means the Syndicate of the University.
1.3 'Academic Council' means the Academic Council of the University.
1.4 'Committee of Courses and Studies' means the Committee of Courses for Undergraduate and Postgraduate Studies of a Degree Awarding Department of the University formed as per rules of the University.
1.5 'Faculty' means the Faculty of Engineering of the University.
1.6 'Academic Committee' means academic committee of the department formed as per statute of the University.

2. Departments

2.1 Degree Awarding Departments

The Faculty shall consist of the following Degree Awarding Departments:
2.1.1 Department of Applied Physics and Electronic Engineering (abbreviated as **APEE)**,
2.1.2 Department of Applied Chemistry and Chemical Engineering (abbreviated as **ACCE**),
2.1.3 Department of Computer Science and Engineering (abbreviated as **CSE**),
2.1.4 Department of Information and Communication Engineering (abbreviated as **ICE**),
2.1.5 Department of Materials Science and Engineering (abbreviated as **MSE**),
2.1.6 Any other department to be instituted by the Syndicate on the recommendation of the Academic Council.

2.2 Related Teaching Departments

The Faculty may require the participation of some or all of the following Departments to teach Humanities, Mathematics and Basic Science courses:
2.2.1 Department of Chemistry, RU,
2.2.2 Department of Physics, RU,
2.2.3 Department of Mathematics, RU,
2.2.4 Department of Statistics, RU,
2.2.5 Department of English, RU,
2.2.6 Department of Law and Justice, RU,
2.2.7 Department of Economics, RU,
2.2.8 Department of Management, RU,
2.2.9 Department Accounting and Information System, RU,
2.2.10 Department of Sociology, RU,
2.2.11 Department of Psychology, RU,
2.2.12 Any other department as per requirements of syllabus of any department of the Faculty.

3. Degree Offered

The Faculty shall offer courses leading to the award of the following degrees:
3.1 Bachelor of Science in Applied Physics and Electronic Engineering abbreviated as B. Sc. Engg. (APEE),
3.2 Bachelor of Science in Applied Chemistry and Chemical Engineering abbreviated as B. Sc. Engg. (ACCE),
3.3 Bachelor of Science in Computer Science and Engineering abbreviated as B. Sc. Engg. (CSE),
3.4 Bachelor of Science in Information and Communication Engineering abbreviated as B. Sc. Engg. (ICE),
3.5 Bachelor of Science in Materials Science and Engineering abbreviated as B. Sc. Engg. (MSE),
3.6 Any other degree that may be awarded by a department on the approval of the Syndicate on the recommendation of the Faculty and the Academic Council.

4. Duration of Course and Course Structure

4.1 The B. Sc. Engg. programmes shall extend over a period of four academic years, each of a normal duration of one calendar year, divided into 2 Semesters; (details are given in Section 7 of the ordinance).

4.2 The curricula of the B. Sc. Engg. Degree in the different departments shall be proposed by the Committee of Courses and approved by the Syndicate on the recommendation of the Academic Council.

4.3 The Committee of Courses shall review the curricula at least once in every **Academic Year** and recommend changes and revision, if any, to the Faculty, and then the Faculty will recommend to the Academic Council .

4.4 Teaching of the courses is reckoned in terms of credits and the credits allotted to various courses will be determined by the Committee of Courses under the following guidelines;

Nature of course	Contact hour/credit (in a semester)
Theoretical Lecture	: 1 hour/week
Laboratory/Project	: 2 - 3 hours/week
Field work	: 2 weeks of field work

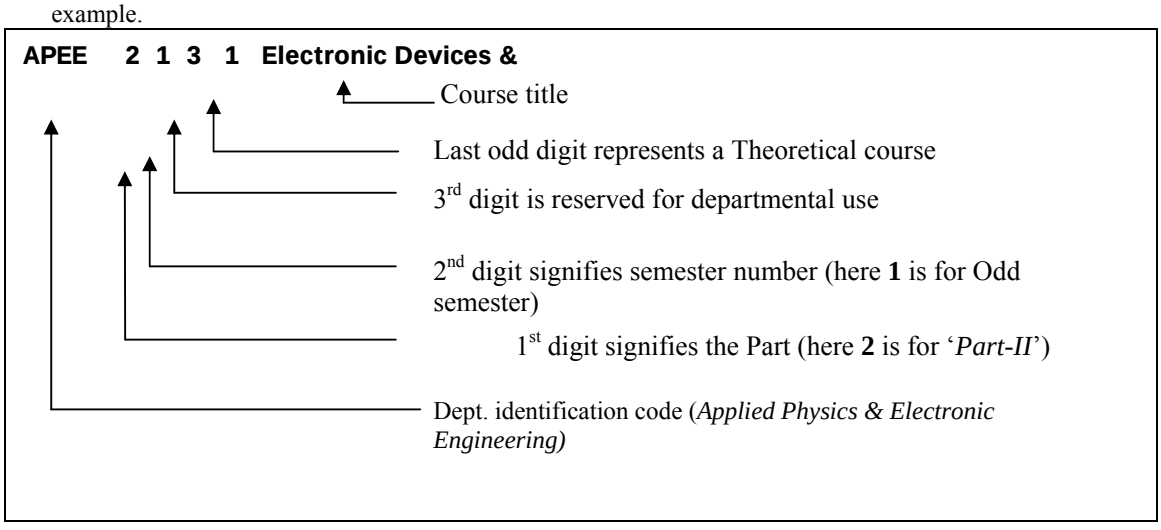
4.5 **Contact Hours/week:** The total contact hours for the regular students including lecture, tutorial and laboratory shall be between **24 - 42** periods per week, each period being **40 to 60** minutes in duration.

4.6 **Course Adviser**: In each degree-awarding department, one of the teachers nominated by the Academic Committee shall act as **Course Advisor** for each academic year.

4.7 With the approval of Academic Committee, Course Advisor will prepare and announce the class routine, showing details of the lectures, course plan, class test, etc. at the start of each semester.

4.8 C**ourse Designation:** Each course is designated by **a two to four letter** word usually identifying the course offering department followed by **a four-digit** number with the following criteria without any space between letters and numerical.

(a) The first digit will correspond to the Part (year) in which the course is normally taken by the students, (b) The second digit will correspond the semester (**1 for odd and 2 for even**) in which the course is normally taken by the students, (c) The third digit will be reserved for departmental use for such things as to identify different areas within a department, (d) The last digit will be **odd for theoretical, even for laboratory courses and '0' for Board Viva voce** and (e) The course designation system is illustrated by the following example.



5. Distribution of Courses

The program of study for the B. Sc. Engg. shall carry a total of **160** credits (**4000** marks).

Suggested distribution of courses is as follows:

Course type		Marks	% of Marks	Credits
[a]Humanities		100 – 300	2.5 – 7.5	4– 12
[b] Basic Sciences (with Lab)		600 – 900	15 – 22.5	24 – 36
Basic and Major Engineering		2800 – 3200	70 – 80	112 – 128
Distribution	(i) Basic Engineering(with Lab)	100-300	2.5 – 7.5	4– 12
	(ii) Major Engineering			
	(a) Theoretical	1500 – 2400	37.5 – 60	60- 96
	(b) Board Viva-voce	50 - 200	1.25 - 5	2 - 8
	(c) Laboratory	700 – 1200	17.5 - 30	28 - 48
Total		**4000**	**100%**	**160**

[a]Each department must include a course on English.
[b]Each department must include courses on Physics, Chemistry and Mathematics.

6. Marks and Credits Distribution

6.1 Limits of Marks, Credits and Contact Hours Distribution (as per Semester):

6.1.1 **Part I (Odd /Even semester)**

Nature of course		Marks	Credits	Contact hours/week
Humanities		0 - 100	0 - 4	0 - 4
Basic Sciences		50 - 250	2- 10	2- 10
Basic and Major Engineering	Theoretical	50- 200	2 - 8	2 - 8
	Laboratory	50 - 150	2 - 6	4 -12
	Board Viva voce	0 - 100	0 - 4	-
Total		**500**	**20**	**20 - 26**

6.1.2 **Part II (Odd /Even semester)**

Nature of course		Marks	Credits	Contact hours/week
Humanities		0 - 100	0 - 4	0 - 4
Basic Sciences		50 - 250	2 - 10	2 - 10
Basic and Major Engineering	Theoretical	50 - 300	2 - 12	2 - 12
	Laboratory	50 - 150	2 - 6	4 -12
	Board Viva voce	0 - 100	0 - 4	-
Total		**500**	**20**	**20 - 26**

6.1.3 **Part III & IV (Odd /Even semester)**

Nature of course		Marks	Credits	Contact hours/week
Humanities		0 - 100	0 - 4	0 - 4
Basic and Major Engineering	Theoretical	200 - 400	8 - 16	8 - 16
	Laboratory	50 - 200	2 - 8	4 -16
	Board Viva voce	0 - 100	0 - 4	-
Total		**500**	**20**	**20 - 26**

*Laboratory (Experiments/Project/Field Work/ In-Plant Training/Workshop/Similar courses).
Board Viva-voce (marks 50 – 100) can be taken in one or more Even Semesters.
Ordinarily five theoretical courses may be offered in a semester.
If necessary in a semester a department can offer credits between 18 and 22.

6.2 Distribution of Marks (as per course types)

6.2.1 **Theoretical Courses:**

Class Attendance	10%
Quizzes/Class Test	20%
Semester Final Examination	70%
Total	100%

6.2.2 **Laboratory/Field Work*:**

Class Attendance	10%
Quizzes and Viva-Voce	30%
Practical/Design Work/Report	60%
Total	100%

6.2.3 **Project Work**

Internal Examiner (Supervisor) (Based on performance, regularity, quality of analysis, design, organization, writing style)	**35%**
External Examiner (Any teacher from the panel of examiners) (Based on quality of analysis, design, organization, writing style)	**35%**
Presentation and oral Examination	30%
Total	100%

6.2.4 **Basis for awarding marks for class participation and attendance:**

Attendance	Marks (%)
90% and above	100
85% to less than 90%	90
80% to less than 85%	80
75% to less than 80%	70
70% to less than 75%	60
65% to less than 70%	50
60% to less than 65%	40
less than 60%	0

6.3 Duration of Examination

Duration of Theoretical **examination of different courses** at the end of semester shall be as follows :

Courses less than or equal to 2 Credits	2 Hours
Courses greater than 2 credits but less than or equal to 4 Credits	3 Hours

7. Academic Calendar

7.1 The academic year shall be divided into two semesters each having duration of **not less than 11 teaching weeks**.

7.2 There shall be final examinations at the end of each semester conducted by the respective Examination Committee of the Departments.

7.3 **An academic schedule** for the academic year shall be announced for general notification before the start of the academic year, on the approval of the Academic Committee. The schedule may be prepared according to the following guidelines:

Semester-Odd (19 weeks)	Number of weeks
Teaching	**11** (66 working days)
Preparatory Leave	**2**
Examination Period	**2 - 3** ┐
Result Publication	**3 - 4** ┘ **6**
	19

Inter Semester Recess	**1**
Semester-Even (19 weeks)	
Teaching	**11** (66 working days)
Preparatory Leave	**2**
Examination Period	**2 - 3** ┐
Result Publication	**3 - 4** ┘ **6**
	19
Vacation (Summer, Ramadan, and Others)	**13**
Total:	**52**

8. Admission

8.1 The four academic years of study for the degree of B. Sc. Engg. shall be designated as Part-I, Part-II, Part-III and Part-IV in succeeding higher levels of study. Students shall generally be admitted into the Part-I class. In special cases students may be admitted into a higher class on the recommendation of the appropriate Equivalence Committee and Department concerned, only in case of transferred students.

8.2 A candidate for admission into the Part-I class must have passed the HSC Examination (with a minimum **GPA** as decided by the Admission Committee of RU) from a Board of Intermediate and Higher Secondary Education in Bangladesh (after 12 years of Schooling) with Physics, Chemistry and Mathematics as his/her subjects of Examination of the Higher Secondary level or examination recognized as equivalent and must also fulfill all other requirements as may be prescribed by the Admission Sub-Committee of the University.

8.3 The rules and conditions for admission into **different Departments** shall be framed by the Academic committee on the recommendation of the Admission Committee of the University.

8.4 All candidates for admission into the courses of B. Sc. Engg. must be citizens of Bangladesh unless the candidature is against the seats that are reserved for foreign students. Candidates for all seats except the reserved ones, if any, shall be selected on the basis of merit. The rules for admission into the reserved seats shall be framed by the Academic Council on the recommendation of the Admission Committee of the University.

8.5 Admission of a newly admitted student in the Part-I class will be **cancelled** if he/she remains absent for **two consecutive weeks** after the start of class without previous permission.

8.6 Admission test:

8.6.1 The admission test shall be conducted by the Faculty (**or as suggested by the Admissior Committee, R.U.)**

8.6.2 The admission Committee of the Faculty shall be formed as per guidelines given below:
(a) Dean of the Faculty as Chief Coordinator,
(b) All the Chairmen of the Departments as Coordinator and
(c) One teacher from each member Department (nominated by the concerned Academic Committee) as Member.

8.6.3 The committee formed under **clause** 7.8.2, shall form other necessary sub-committee(s), appoin question setters and take other necessary decisions.

8.6.4 A merit list shall be prepared based on candidates' GPA in SSC/equivalent and HSC/equivalen examinations and admission test results, or as decided by the University admission Committee.

8.6.5 Admission into different Departments of the Faculty shall be granted from the **single merit lis** according to the position and choice of the candidate.

9. Admission on Transfer

A candidate seeking admission on transfer from other Institutes or Universities should apply to the Registrar of the University. The Registrar will refer the case to the **Chairman** of the Department concerned and also to the Equivalence Committee. On receiving the opinions of the academic committee of the Department and of the Equivalence Committee, the matter will be placed to the Vice-Chancellor. The Vice-Chancellor's decision will be communicated to the **Chairman** of the Department and the candidate.

10. Medical Examination at the Time of Admission

Every student after being admitted to the University shall be examined by a competent medical officer as may be provided in the admission rules.

11. Registration

University Registration: Every student admitted into the University shall be required to register on payment of the prescribed fees within the stipulated time.

12. Change of Department

Change of department is not allowed in general. However, under very special circumstances if a student wants to change a subject of study in Part-I, prayer may only be considered by **the Dean of Faculty** after getting opinions from the Academic Committee of the Departments concerned. No change will be allowed in Part-II, Part-III and Part-IV levels.

13. Attendance

13.1 In order to be eligible for appearing, as a regular candidate, at the semester final examinations, a student shall be required to have attended at least 70% of the total number of periods of lectures/tutorials/laboratory classes held during the semester in every **course** as defined in the curricula. The laboratory courses mean all laboratory/project/fieldwork/in-plant training and any other similar courses.

13.2 A student whose attendance falls short of 70% but not a below 60% in any **course** as mentioned above may be allowed to appear at the final examinations as **non-collegiate** student and **he/she shall not be eligible for the award of any scholarship or stipend.** A student, appearing at the examination under the benefit of this provision shall have to pay, in addition to the regular fees, the requisite fine prescribed by the syndicate for the purpose.

13.3 The **Courses** mentioned above shall mean a **course** of study as described in the curricula and it may be a theoretical or a laboratory **course**.

13.4 Students having **less than 60% attendance** in lecture/tutorial/ laboratory of **any course will not be allowed to appear** at the final examinations of the semester.

13.5 An attendance report of the students shall be prepared by the concerned course teacher for his/her Class. The report will be posted for information of the students to **the Chairman of concerned department** within three days of the last class of the course. Awarded marks for class attendance of the students will be posted in the prescribed marks sheet. A copy of that marks sheet will send to the chairman of the examination committee and to the controller of examinations as well in sealed envelope.

14. Grading System

14.1 The letter grade system for assessing the performance of the students shall be as follows:

Marks	Letter Grade (LG)	Grade Point (GP)
80% or above	A+	4.0
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.5
65 to less than 70%	B+	3.25
60% to less than 65%	B	3.0
55% to less than 60%	B-	2.75
50 to less than 55%	C+	2.5
45% to less than 50%	C	2.25
40 to less than 45%	D	2.0
less than 40%	F	0.0
Incomplete	I	0.0

A letter grade 'I' (incomplete) shall be awarded for courses in the odd semester which continue through to the even semester.

14.2 A **Grade Point Average (GPA)** shall be calculated for each semester as follows:

$$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \qquad \text{(i)}$$

where, n is the number of courses offered during the semester, C_i is the number of credits allotted to a particular course and G_i is the grade point earned for that course.

14.3 A **Yearly Grade Point Average (YGPA**) shall be calculated for each academic year as follows:

$$YGPA = \frac{\sum_{j=1}^{2} C_j G_j}{\sum_{j=1}^{n} C_j} \qquad \text{(ii)}$$

where 2 is the number of semester, C_j is the number of credits allotted to a semester and G_j is the GPA earned for that semester.

14.4 The **Cumulative Grade Point Average (CGPA)** gives the cumulative performance of the students from the 1st year up to the end of the year to which it refers, and will be calculated as follows:

$$CGPA = \frac{\sum_{k=1}^{m} C_k G_k}{\sum_{k=1}^{m} C_k} \qquad \text{(iii)}$$

where, m is the total number of years being considered, C_k is the total number of credits registered during a year and G_k is the YGPA of that particular year.

14.5 A Cumulative Grade Point Average (CGPA) shall be calculated at the end of each academic year and to be communicated to the students along with the YGPAs. The individual grades of courses obtained by them for the semesters of the academic year will, however, be communicated at the end of individual semester by the Chairman of the Examination Committee.

14.5 Both YGPA and CGPA will be rounded up to the second place of decimal for reporting. **For instance, YGPA=2.212 shall be rounded off as YGPA=2.22.**

14.6 **Earned Credit:** The courses in which a student obtains minimum 'D' in 'Theoretical courses' and 'C' in 'Laboratory courses & Board Viva-voce' or higher grade will be counted as credits earned by the student. Any course in which a student obtains 'F' grade will not be counted towards his/her earned credit. 'F' grade will not be counted for GPA calculation but will stay permanently on the Grade Sheet and transcripts.

15. Conducting Examination and Rules for Promotion

15.1 The academic year shall be divided into two semesters each having duration of not less than 11 teaching weeks (details are given in Section 7 of the Ordinance).

15.2 There shall be final examinations conducted by the concerned Examination Committee of the Departments at the end of each semester.

15.3 The results shall be finalized at the end of the even semester of the academic year. A student entering in an odd semester **shall automatically move** on to the next semester, unless he/she was **barred** from appearing at the final examinations at the end of the semester. Individual **course** grades and **GPA** shall be announced within a date ordinarily not later than three weeks after the end of the semester final examinations.

15.4 **Minimum passing grade:** The minimum passing grade in a theoretical course will be D and the minimum passing grade in a laboratory/project/field work/in-plant training/workshop/similar Courses (henceforth referred to as laboratory course) and **Viva voce** will **be C.**

15.5 **Promotion to higher class:** In order to be promoted to higher class a student must obtain the following requirements:

i) Yearly Grade Point Average (YGPA) of 2.25 or higher
ii) Credit point loss (F or I Grade) in the theoretical courses not more than 10.
iii) Minimum C grade in the laboratory courses and viva-voce.

15.6 **Course Improvement**: A promoted student may appear for course improvement in the immediate next academic year for maximum 10 credit points to clear his/her F grade or to improve the grades on the courses in which less than B grade (including those of F grade) was obtained in Part-1, Part-2 and Part-3 examinations. In such case, the student has to give his/her choice of course/courses for course improvement in writing. If the student fails to clear his/her F grades in the first attempt, he/she shall got another (last) chance in the immediate next year to clear the F grades**.** In the case of student's failure to improve his/her course grade at the course improvement examination, the previous grade shall remain valid.

15.7 **rse Exemption:** Students who fail to be promoted to the next higher class shall be exempted from taking the theoretical and laboratory courses where they obtained grades **equal to B or above.** These grades would be counted in calculating GPA in the next year's examination results.

15.8 **it Position:** The YGPA obtained by a student in the **semester final examinations** will be considered for determining the **merit position for the award of scholarships, stipends etc.**

16. Class Test

16.1 **For theoretical** courses of **less than or equal to 2 credits** there shall be at **least three** class tests and at **least four** class tests for **greater than 2 credits in a** semester.

16.2 The course teacher must submit the detailed class test marks and their average in percentage to the Chairman of the Examination Committee in a sealed envelope. A copy will be also sent to the controller of the examination. If a course is conducted by more than one course teacher, class test marks will be processed by the examination committee.

16.3 Previous class test marks will remain valid for the reported/ course improvement student if he/she is unable to appear at class test.

17. Publication of Results

17.1 **Award of degree**: In order to qualify for the B.Sc. Engg. degree, a student must have to **earn minimum 150 credits and a minimum CGPA of 2.25 within a maximum of six academic years**. The result will be published in accordance with merit.

17.2 **Honours**: Candidates for Bachelor degree in engineering will be awarded the degree with Honours if their earned credit is 160 and **CGPA is 3.75 or higher.**

17.3 **Result Improvement:** A candidate obtaining B.Sc. Engg. within 4 or 5 academic years shall be allowed to improve his/her result, of maximum of 10 credit points (courses less than 'B' grade) of the Part-IV theoretical courses in the immediate next regular examination after publication of his/her result. No improvement shall be allowed for laboratory examinations and Board Viva-voce. If a candidate fails to improve CGPA with the block of new GP in total, the previous results shall remain valid.

17.4 **Readmission and Course Exemption:** If a student fails to obtain the degree within 4 or 5 academic year, he/she will be readmitted in Part-4 and will appear for the exam according to the clause 15.6. Course exemption rules will also be valid according to clause 15.7.

17.5 **Dean's List:** As a recognition of excellent performance, the names of students obtaining a cumulative GPA of 3.75 or above in two regular semesters in each academic year may be published in the Dean's List in the faculty. Students who have received **an 'F' grade** in any course during any of the two regular semesters will not be considered for Dean's List in that year.

17.6 **Recording of Result:** The transcripts in English will show the course designation, course title, credit, letter grade, grade point of individual courses, YGPA of each year, and finally, CGPA.

18. Examination Committee

18.1 The Examination Committee shall be proposed by the departmental Academic Committee and is subject to the approval of Vice-Chancellor. There shall be one examination Committee for each part of examinations in each degree-awarding department: The committee shall consist of

i) Chairman of the examination committee from the concerned department
ii) Three other members belonging to the concerned department,
iii) One expert member from outside the department/university,
iv) Maximum four members from the respective related teaching departments provided any related course is present in that part of the examination. Depending on the number of related courses in each semester, the corresponding members will work in odd semester and the others will work in even semester. (The related means all Humanities, Basic Science and Engineering Courses).

18.2 **Functions of the Examination Committee**

18.2 1 Propose the names of the question setters and script//dissertation/project/ in-plant training report examiners from the previously approved panel of examiners.

18.2.2 Moderate examination questions of all courses,

18.2.3 Propose examination schedule (for approval of the departmental Academic Committee) to conduct the examinations properly,

18.2.4 Make necessary arrangements for holding the examination of all **Theoretical and Laboratory examinations as well as Board Viva voce** (as given in Sections 6.1, 15, 19, 20),

18.2.5 Process continuous assessment (attendance and class test) marks sent by the course teacher.

18.2.6 Recommend the names of three tabulators (for approval of the Vice-Chancellor). Tabulators will post marks **both in the rough and the final** tabulation sheets, the rough copy will be kept by the Chairman of the Examination Committee and the final sheets will be submitted to the Controller of Examination,

18.2.7 Finalize the results (as per given rules in Sections 14, 6, 17), and

18.2.8 Related department member may only propose the names of the question setters or moderate the related courses and they are not able to be involved in other function of the examination committee.

18.4 **Chairman of the Examination Committee:** The Chairman of the Examination Committee shall be proposed by the departmental Academic Committee.

18.5 **The major duties of the Chairman of an Examination Committee shall be as follows:**

18.5.1 Call meetings of the Examination Committee,

18.5.2 Either to send the moderated question papers to the Controller of Examinations for printing or to take necessary steps for printing the questions in his/her own care.

18.5.3 Issue instructions to the examiners as per approval of the Examination Committee concerned and to see that instructions issued are properly followed and

18.5.4 Hand over the marks received from the examiners to the tabulators.

19. Theoretical Examination and Board Viva voce

19.1 There shall be two examiners for each theoretical course of each semester final examination, at least one of whom shall be the teacher of the course. Each question paper of a course will be divided into two sections: **Section A and Section B.** Each examiner will set questions for both the sections and examine answer scripts of one of the sections as will be decided by the Examination Committee. Student will use separate answer scripts to answer questions from each section.

19.2 In each theoretical course examination, the candidates shall be allowed a choice of question to the extent of not more than **33%** of the total number questions to be answered.

19.3 Scripts examined by a single examiner shall be scrutinized for any error and omissions by the scrutinizer. The Vice-Chancellor or his authorized officer on the recommendation of the Examination Committee shall appoint such scrutinizer.

19.4 Where there is an arithmetical error in the adding of marks, the scrutinizer shall bring it to the notice of the Chairman of the Examination Committee and the Examination Committee shall make corrections in these cases.

19.5 The answer scripts of the examinations shall not be shown to the students nor re-examined for the purpose of re-assessing the answers, but may be re-scrutinized for errors and omissions only. Such re-securitization may be made on receipt of a formal application from a candidate together with the prescribed fee. No application shall be entertained unless it reaches the appropriate authority within fifteen days of the publication of such results. The scrutiny shall be arranged in a manner as may be considered appropriate by the Chairman of the Examination Committee.

19.6 Absence of a candidate in an examination of a **course** in which he/she ought to have been present will be considered as if the candidate obtained zero marks **('F' grade)** in that **course**.

19.7 The concerned Examination Committee will conduct the **Board Viva voce.**

20. Laboratory Examination/Field Work/Professional Training

20.1 The concerned Lab teachers nominated by the Examination Committee will conduct **Lab Viva voce**.

20.2 The departmental Academic Committee will assign a teacher or a group of teachers to conduct a particular laboratory class or all the laboratory classes of a particular semester of a particular year, as well as to conduct the laboratory examination of that class **during the scheduled course periods**.

20.3 One copy of the marks of the laboratory examination will be sent to the Chairman of the concerned Examination Committee, and another copy will be sent to the Controller of Examinations of the University.

20.4 Depending on each department's own requirements, a student may have to complete a prescribed number of days of industrial/professional training in addition to minimum credits and other requirements, to the satisfaction of the concerned department

21. Medium of Answers

The medium of answer in the examination of all written, laboratory and other courses of each subject will be either English or Bengali, as directed by the concerned Department.

22. Duties and Responsibilities of Question Setters and Script Examiners

22.1 If a question setter or a script examiner is unable to accept the appointment before or during the examination, he/she should immediately inform the Controller of Examinations. In case an examiner cannot finish marking the scripts received by him/her or within the specified time (maximum 8 days), he/she should immediately return the scripts to the Chairman of the Examination Committee. The Examination Committee has all the rights to change and set the script examiner immediately in that case.

22.2 The question setters and the script examiners should send their remuneration bills to the Controller of Examination. All postal and other incidental expenses incurred by the setters/examiners in connection with the examination will be paid by the University on presentation of duly signed bill for the same, supported by vouchers.

22.3 If any examiner is unable to accept or has to relinquish his/her appointment, the Examination Committee concerned shall recommend to the Controller of Examinations new question setter or script examiner.

22.4 All manuscripts/question papers shall be sent by the setters in a sealed covers to the Chairman of the Examination Committee who shall then call a meeting of the Examination Committee who will arrange for moderation of the papers.

22.5 The question papers, scripts and any other documents in connection with the examination would be handed over officially/personally or sent by insured post to the Chairman of the respective Examination Committee.

22.6 The marks of all examinations shall be submitted to the Chairman of the Examination Committee, either personally in a sealed cover or in a doubly sealed insured cover, if sent by post. A copy should also be submitted separately to the Controller of Examinations of the University.

22.7 The question setter shall as far as practicable, avoid in marked change of standard from year to year but shall not be required to set the same type of questions every year. The question shall be so framed that there shall be no ambiguity of meaning. The questions should be set in such a way that originality and individuality of the candidates may be encouraged.

22.8 The question setter shall be guided as to the standard extent of knowledge required and scope of the courses of examination by the syllabus prescribed and the textbook, if any, recommended by the University from time to time.

22.9 All corrections and alterations in the manuscripts, question papers, marks placed in the scripts and marks entered in the marksheets must invariably be initiated by the person making the correction. Over-writing in the case of marks should be avoided. The wrong figures should be crossed out and the correct figures written in convenient places. Doubtful entries should be indicated by words as well.

22.10 If in the course of examining the answer scripts the examiner have reasons to suspect that unfair means have been adopted by any candidate, he/she should at once submit confidential report to the Chairman of the respective Examination Committee giving the grounds for his/her suspicion.

22.11 The marks of each course of examination or a section are to be submitted to the Chairman of the respective Examination Committee. A copy should also be submitted separately to the Controller of Examinations of the University.

22.12 If any examiner is unable to examine answer script, he/she should return the packet of answer scripts immediately to the Chairman of Examination Committee.

22.13 Immediately on receipt of each packet containing answer scripts of candidates, the examiner should count the script and verify the figures given in the statement regarding the details of the answer scripts sent. Should any discrepancy be discovered, it should at once be brought to the notice of the Chairman of the Examination Committee with a report of the statement which should be filled in and returned to the Chairman of the Examination Committee immediately after receiving the answer scripts, so that prompt action may be taken about the matter. If no report is received within three days of receipt, it will be assumed that the statement sent is correct.

22.14 **The question setters are particularly requested**

22.14.1 The manuscripts of the questions are to be written in English. To make sure that the manuscripts of questions are as clear and legible as possible, taking special care in writing, so as to ensure accuracy in printing,

22.14.2 No copy of the question paper framed by him/her shall be retained and all rough draft and memorandum connected therewith should be destroyed immediately after being used properly, and,

22.14.3 Sign at the bottom of each sheet of the manuscript question paper set by him.

23. Eligibility for Examination

23.1 A candidate may not be admitted to any semester final examination unless he/she has

23.1.1 Submitted application in the prescribed form to the Registrar/Vice-Chancellor for appearing at the examination,

23.1.2 Paid the prescribed examination fees, and all outstanding University and Hall dues,

23.1.3 Fulfilled the conditions for attendance in class and

23.1.4 Been barred by any disciplinary rule.

23.2 On special circumstances the Vice-Chancellor may permit a student to appear at the examination.

23.3 A student whose attendance falls short of 70% but not below 60% in any course as mentioned above may be allowed to appear at the final examinations as a non-collegiate student.

24. Amendment

Any amendment of this ordinance shall be proposed through the Faculty of Engineering and passed by the Academic Council

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Marksheet

Dept. of ……, RU
B. Sc. Engg. Part-1/2/3/4 Semester: Odd □ Even □ Exam Year: 20…..
Course Code: Section- A □ B □
Course Title: No. of Class Test:

Full Marks	Marks in each sec	Attendance	Class Test	Theory
100	50	5	10	35
75	37.5	3.75	7.5	26.25
50	25	2.5	5	17.5

Roll No.	Theory Exam	Class Test	Attendance	Total

Name: **Signature**
Date: