University of Rajshahi
Faculty of Engineering

Department of Applied Physics and Electronic Engineering

Syllabus for M. Engg. Course
Session: 2014 – 2015
Examination - 2015

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The Master of Engineering in Applied Physics and Electronic Engineering abbreviated as M. Engg. (APEE) degree is based on course work with a project and practical. The duration of the degree shall be 3 semesters of 6 months each. The degree shall have a total of 60 credits and 1500 marks distributed over the 3 semesters. A candidate must complete all requirements for the degree within **three and half** academic years from the date of his/her first admission.

1. Distribution of Courses

The Master's programme shall have a total of 60 credits and distributed as follows:

Nature of Course	**Credits**
Theoretical	36
Practical	14
In-plant training	2
Project	4
Viva-voce	4
Total	**60**

2. Academic Calendar

2.1 The duration of the M. Engg. programmes shall be 3 semesters, duration of each semester shall be **not less than 11 teaching weeks**.

2.2 There shall be final examination at the end of each semester conducted by the relevant examination committee of the departments.

2.3 **Academic schedule** shall be published before the start of the 1st semester, on approval of the Academic Committee. The schedule may be prepared according to the following guidelines:

1st Semester (19 weeks)	Number of weeks
Teaching	11 (66 working days)
Preparatory Leave	**2**
Examination Period	**2 - 3**
Result Publication	**3 - 4**
Total:	**19**

Vacation including Inter-Semester Recess	1 week

2nd Semester (19 weeks)	Number of weeks
Teaching	11 (66 working days)
Preparatory Leave	**2**
Examination Period	**2 - 3**
Result Publication	**3 - 4**
Total:	**19**

Vacation (Summer, Ramadan, and Others) including Inter-Session Break.	13 weeks
(1st Semester+2nd Semester) Total:	**52 weeks**

3rd Semester (26 weeks)	Number of weeks
Teaching	11 (66 working days)
Preparatory Leave	**2**
Examination Period	**3 - 4**
Result Publication	9 **- 10**
Total:	**26**

(1st Semester+2nd Semester+3rd Semester) Total:	**78 weeks**

3. Attendance

3.1 In order to be eligible for appearing at the semester final examinations as a regular candidate, a student shall be required to have attended at least 70% of the total number of lectures/tutorials/laboratory classes held in every course. The laboratory courses mean all laboratory/project/fieldwork or similar courses.

3.2 A student whose attendance is between 60% and 69% in any **course** may be allowed to appear at the final examinations as an irregular student but **he/she shall not be eligible for any scholarship or stipend.**

3.3 Student having **less than 60% attendance** in any course **will not be allowed to appear** at the final examinations of the semester.

3.4 The concerned course teacher shall prepare an attendance report of the students. The report will be submitted to **the Chairman** of the Department within 3 days of the **last** class of the **courses**. During the middle of a semester, the teacher will also submit a mid-semester attendance report. **Awarded marks for class attendance of the students shall also be prepared by the concerned course teacher and submitted to the Chairman of the Examination Committee and to the Controller of Examination in a sealed cover.**

3.5 The percentage of attendance of the readmitted students shall be counted from the date of the start of the semester or from his/her previous attendance of the semester.

4. Striking off the Names and Readmission

4.1 The names of the students shall be struck off and removed from the rolls on the following grounds:

4.1.1 Non-payment of University fees and dues within the prescribed period,

4.1.2 Failing to get himself/herself promoted to the next higher semester,

4.1.3 Forced to discontinue **his/her** studies under disciplinary rules,

4.1.4 Withdrawal of names from the rolls of the University on grounds acceptable to the Vice-Chancellor of the University after having cleared all dues.

4.2 In case a student, whose name has been struck off the rolls under clause 4.1.1 seeks readmission **before the start of the next semester** he/she shall be readmitted on payment of all the fees and dues. But if he/she seeks readmission in any subsequent **semester**, the procedure for his/her readmission will be the same as described under **clause** 4.4 below.

4.3 In case a student, whose name has been struck off the rolls under clause 4.1.2 seeks readmission **before the start of the next semester** he/she shall be readmitted on the approval of the relevant department on payment of all the arrear fees and dues.

4.4 A Student, whose name has been struck off the rolls by exercise of the clause 4.1.3, seeking readmission after expiry of the suspension period, shall submit an application to the Chairman of the Department before the commencement of the semester to which he/she seeks re-admission. The Chairman of the Department shall forward the application to the Vice-Chancellor. In case the readmission is allowed, the student will be readmitted on payment of all the fees and dues within one week from the date of permission given by the Vice-Chancellor.

4.5 In case any application for readmission is rejected the student may appeal to the Academic Council for re-consideration. **The decision of the Academic Council shall be final.**

4.6 No student who has withdrawn his/her name under clause 4.1.4 shall be given readmission.

4.7 All re-admission should preferably be completed before the semester starts.

4.8 The application of a student for readmission will only be considered if he/she applies within **one year** from the date he/she discontinued his/her studies in the University. **The maximum period of studies** for M. Engg. degree under **no circumstance will exceed three and half academic years.**

5. Grading System

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

Numerical grade	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 that could not be completed in one semester, which will continue through to the next semester.

5.2 A Semester wise Grade Point Average (SGPA) shall be computed for each semester. The SGPA will be calculated as follows:

$$\text{SGPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$$

where, n is the number of courses offered during the semester, Ci is the number of credits allotted to a i'th course and Gi is the i'th grade point corresponding to the grade awarded for that course.

5.3 A Cumulative Grade Point Average (CGPA) shall also be computed at the end of second and third semester in the following way:

$$CGPA = \frac{\sum_{i=1}^{m} S_i C_i}{\sum_{i=1}^{m} C_i}$$

where, m is the total number of semesters being considered, Si is the SGPA of a i'th semester, Ci is the total number of credits in i'th semester.

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

5.5 Earned Credit: The courses in which a student has obtained minimum 'D' in 'Theoretical courses' and 'C' in 'laboratory, in-plant training and viva voce' will be counted as credits earned by the student. These grades will not be counted for SGPA/CGPA calculation but will stay permanently on the Grade Sheet and transcripts.

6. Marks and Credit Distribution

6.1 Distribution of Marks (as per course types)

6.1.1	**Theoretical Courses**	i) Class Participation and Attendance ii) Quizzes/Class Test/Assignment iii) Semester Final Examination	10% 20% 70%
6.1.2	**Laboratory/ Field Work**	i) Class Participation and Attendance ii) Quizzes and Viva-Voce iii) Practical/Design Work/Report	10% 30% 60%
6.1.3	**Project Work**	i) **Internal Examiner (Supervisor)** (Based on performance, regularity, quality of analysis, design, organization, writing style) **ii) External Examiner**	35% 35%
		(Any teacher from the panel of examiners) (Based on quality of analysis, design, organization, writing style) iii) **Presentation and Oral Examination** (will be conducted by respective examination committee)	30%
6.1.4	**In-plant Training**	**Report evaluation (by two internal examiners) (Average)**	100%
6.1.5	**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

6.2 Credits Distribution

Table-6.2

Semester	Nature of course	Credit
1st semester	Theoretical	12
	Practical	6
	Total	**18**
2nd semester	Theoretical	14
	Practical	4
	In-plant training	2
	Total	**20**
3rd semester	Theoretical	10
	Practical	4
	Project	4
	Viva-voce	4
	Total	**22**

(1st semester + 2nd semester + 3rd semester) Total	**60**
***Industrial and Professional Training Requirements:** *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 credit and other requirements, to the satisfaction of the concern department.* ***Project and field study trip:** *The Chairman of the Department through Academic Committee shall arrange for holding Project and Field study trip.*	

6.3 Duration of Examination

Duration of **Theoretical examination of different courses** shall be as follows:

Courses of 2 credits or less than 2 Credits	2 Hours
Courses of more than 2 credits	3 Hours

7. Conduct of Examination and Rules for Promotion

7.1 There shall be final examinations at the end of each semester conducted by the relevant examination committee of the departments.

7.2 The results shall be finalized at the end of the 3rd semester of the program. Individual course grades shall be announced within a date ordinarily not later than 3 weeks after the end of the semester final examinations.

7.3 **Minimum passing grade:** The minimum passing grade in a theoretical course will be D and the minimum passing grade in a laboratory, project, in-plant training and viva-voce course will be C.

7.4 **Promotion to higher semester:** A student who has a grade point average of **2.2** or higher, credit point loss (F or I Grade) in theoretical courses not more than 08 and at least C grade in the laboratory/field work/in-plant training and viva voce courses of the 1st and 2nd semester shall be promoted to the 2nd and 3rd semester, respectively.

7.5 There shall be no improvement in laboratory/field work/in-plant training, project and viva-voce courses. A student failing to secure a minimum C grade in any of these courses in any semester shall fail the semester.

7.6 **Grade Point Improvement**:

7.6.1 A promoted student who obtains less than B grade in theoretical courses in any semester, may appear in the upcoming regular examination of that semester to improve the grade point.

7.6.2 Grade obtained by a student in the courses in which he/she appeared for improvement will be recorded for final assessment according to clause 7.6.1 and the grade obtain by him/her in those courses at the regular final examination shall automatically cancelled.

7.6.3 Clause 7.6.2 is not valid for a candidate who cannot improve his/her course grade; in that case the previous grade shall remain valid.

7.6.4 A student must clear F grade of the courses of all the semesters.

7.7 **Course Exemption:** Students who fail to be promoted to the 2nd and 3rd semester shall be exempted from taking the theoretical and laboratory courses where they obtained grades equal to or better than B**.** These grades would be counted towards calculating SGPA in the retained semesters.

7.8 **Merit Position:** The SGPA obtained by a regular student in a semester final examination will be considered for determining the merit position for the award of scholarships, stipends etc.

8. Class Test

8.1 For theoretical courses of 2 or less than 2 credits there shall be at least three class tests and at least four class tests for greater than 2 credits in a semester, out of which the best two and three respectively, for each student shall be taken for assessment.

8.2 The class test shall have duration of 20 to 30 minutes and shall be held during the scheduled lecture or tutorial periods.

8.3 The Academic Committee of the teaching Departments shall fix and announce the dates for the class tests.

8.4 All class tests shall ordinarily be of equal value and test scripts may be returned to the student before the subsequent test. The result of each individual test shall be posted for information of the students.

8.5 All marks of the class tests shall be summed up by the concerned course teacher and submitted to the Chairman of the Examination Committee and Controller of Examination of Rajshahi University in a sealed cover.

9. Publication of Results

9.1 A student must successfully complete the courses of all the semesters within maximum **three and a half** academic years as outlined by the Committee of Courses with all its pre-requisites in order to be eligible for the award of M. Engg. degree. The student must earn 60 credit points (i.e. no 'F' grade) and the CGPA for the student must be 2.25 or higher.

9.2 The final merit position will be based on CGPA.

9.3 **Dean's Merit List:** As a recognition of excellent performance, the names of students obtaining a CGPA of 3.75 or above in two regular semesters in each academic year may be published in the Dean's **Merit** 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.

9.4 **Recording of Result:** The overall results of a successful student shall be declared on the basis of CGPA with the corresponding letter grade (LG). The Transcripts in English will show the course designation, course title, credit, letter grade and grade point of individual courses. SGPA of each semester, CGPA and corresponding LG for the over-all result**.**

10. Course Distribution:

10.1 Compulsory Courses:

Table- 10.1

Course Codes	Course Titles	Marks	Credits
APEE M 1 101	Power Electronics and Control System	100	4
APEE M 1 102	Advanced Digital Signal Processing	75	3
APEE M 1 103	Advanced Biomedical Instrumentation	75	3
APEE M 1 104	Renewable Energy, Conversion and Storage	50	2
APEE M 2 105	Advanced Communication Engineering	100	4
APEE M 2 106	VLSI Design	100	4
APEE M 2 107	Environmental Geophysics	100	4
APEE M 2 108	Advanced Computer Networking	50	2
APEE M 3 109	Condensed Matter Physics	50	2
APEE M 3 500	Viva-voce	100	4
	Total	**800**	**32**

10.2 Optional Courses (TWO courses from any ONE specialized group; carrying 200 marks and 8 credits):

Table-10.2

	Specialized Groups	Course Codes	Course Titles	Marks	Credits
1	Material Science	APEE M 3 110	Nanoscience and Nanotechnology	100	4
		APEE M 3 111	Thin Film Technology and Computational Materials	100	4
2	Computer and Communication	APEE M 3 112	Wireless Communication and Networking	100	4
		APEE M 3 113	Network Security and Firewall	100	4
3	Geophysics	APEE M 3 114	Environmental Remote Sensing	100	4
		APEE M 3 115	Disaster and Geoinformatics	100	4
4	Signal Processing	APEE M 3 116	Image Processing and Pattern Recognition	100	4
		APEE M 3 117	Speech Processing and Recognition	100	4
5	Plasma Science and Technology	APEE M 3 118	Plasma Science and Technology	100	4
		APEE M 3 119	Plasma Technology for Hyperfunctional Surfaces	100	4
6	Nuclear Engineering	APEE M 3 120	Nuclear Engineering	100	4
		APEE M 3 121	Nuclear Instrumentations	100	4

10.3 Practical / Project:

Table-10.3

M. Engg. programme				
Semester	**Course Code**	**Course Title**	**Marks**	**Credits**
1st semester	APEE M 1 201	Practical-I	150	6
2nd Semester	APEE M 2 202	Practical-II	100	4
	APEE M 2 301	In-plant Training	50	2
3rd Semester	APEE M 3 203	Practical-III	100	4
	APEE M 3 401	Project	100	4
		Total	**500**	**20**

10.4 Courses Offered In Different Semester Are As Follow:

Table-10.4 Courses for M. Engg.

1st Semester				
Course Codes	**Course Titles**	**Marks**	**Credits**	**Contact hours/ week**
APEE M 1 101	Power Electronics and Control System	100	4	4
APEE M 1 102	Advanced Digital Signal Processing	75	3	3
APEE M 1 103	Advanced Biomedical Instrumentation	75	3	3
APEE M 1 104	Renewable Energy, Conversion and Storage	50	2	2
APEE M 1 201	Practical-I	150	6	6
	Total	**450**	**18**	

2nd Semester				
Course Codes	**Course Titles**	**Marks**	**Credits**	**Contact hours/ week**
APEE M 2 105	Advanced Communication Engineering	100	4	4
APEE M 2 106	VLSI Design	100	4	4
APEE M 2 107	Environmental Geophysics	100	4	4
APEE M 2 108	Advanced Computer Networking	50	2	2
APEE M 2 202	Practical-II	100	4	4
APEE M 2 301	In-plant Training	50	2	
	Total	**500**	**20**	
3rd Semester				
Course Codes	**Course Titles**	**Marks**	**Credits**	**Contact hours/ Week**
APEE M 3 109	Condensed Matter Physics	50	2	2
	Optional - 1	100	4	4
	Optional - 2	100	4	4
APEE M 3 203	Practical-III	100	4	4
APEE M 3 401	Project	100	4	
APEE M 3 500	Viva-voce	100	4	
	Total	**550**	**22**	

APEE M 1 101
Power Electronics and Control System
100 marks 4 credits 60 lectures
(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Power Semiconductor Diode, Reverse Recovery Characteristics:** Power diode types, effects of forward and reverse recovery time, series and parallel connected diode, Multiphase star rectifier, Three-phase bridge rectifier, Three-phase bridge rectifier with RL load, Effects of source and load inductance.

2. **Thyristor and Controlled Rectifiers:** Thyristor types, series and parallel operation of thyristors, Programmable Unijunction Transistor, Principle of phase-controlled converter operation, single phase semiconverters, single phase full converters, single phase dual converter, Three phase half-wave converter, three phase semiconverter, three phase full and dual converters, power factor improvement. Thyristor commutation technique, natural commutation, forced commutation.

3. **AC voltage Controllers:** principle of off-on control, principle of phase control, single-phase bi-directional converter with resistive load, three –phase half wave and full wave controller, three phase bi-directional Delta connected controllers, cycloconverters, AC voltage controllers with PWM control.

4. **Power Transistor:** Bipolar junction transistor, MOSFETs, SITs, IGFETs (switching characteristics and switching limits), series and parallel operation.

Section – B

5. **DC chopper:** principle of step-down operation, step-down chopper with RL load, chopper classification, switching-mode regulators, Thyristor chopper circuit, Applications.

6. **Pulse width-modulated inverters and resonant pulse inverters:** Principle of operation of pulse width inverters, three phase bridge inverters, voltage control of single and three phase inverters, series and parallel resonant inverters, class E resonant inverter

7. **DC and AC drives:** Basic characteristics of DC motors, operating models, single phase drives, three phase drives, chopper drives, induction motor drives, synchronous motor drives, Applications.

8. **Protection of devices and circuits:** Cooling and heat sinks, snubber circuits, reverse recovery transients, supply and load side transient, voltage protection by selenium diode and metal oxide varistors, current protection.

Books recommended:
Text Books:

1. Power Electronics : Muhammad H. Rashid
2. Power Electronics : Mohan/Undeland/Robbins
3. Power Electronics : P C Sen

APEE M 1 102
Advanced Digital Signal Processing
75 marks 3 credits 45 lectures
(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Frequency Analysis of Signals and Systems:** Frequency analysis of continuous-time signals, Frequency analysis of discrete-time signals, Properties of Fourier transform, Discrete Fourier transform (DFT), Fast Fourier transform (FFT), Discrete cosine transform (DCT), Frequency domain representation of LTI system, Frequency response of LTI system.

2. **The z-Transform:** Definition, Poles and zeros, Region of convergence (ROC), Properties of ROC, Relation of z-transform to Fourier transform, Properties of z-transform.

3. **Digital Filter Design:** Design of FIR filters using windows, Design of IIR filter by impulse invariance, Design of IIR filter by bilinear transformation, Adaptive filters.

4. **Linear Prediction and Optimum Linear Filter:** Random signals, Correlation functions, Power spectra, Linear prediction, Solution of normal equations – The Levinson-Durbin algorithm, Wiener filters for filtering and prediction.

Section – B

5. **Least-Squares Methods for System Modeling and Filter Design:** System Modeling and Identification – MA, AR and ARMA models, Least square linear prediction filter, FIR least square inverse filter, Predictive deconvolution, Solution of least squares estimation problems, Matrix formulation of least-squares estimation, Cholesky decomposition, Singular-value decomposition.

6. **Power Spectrum Estimation:** Energy density spectrum, Autocorrelation and power spectrum of random signals, Power spectrum estimation using DFT, Nonparametric and parametric methods for power spectrum estimation, Filter bank methods for power spectrum estimation.

7. **Signal Analysis with Higher-Order Spectra:** Use of higher-order spectra, Moments and cumulants of random signals, Higher-order spectra, Linear non-Gaussian processes, Nonlinear processes, Conventional estimators for higher-order spectra – Indirect and direct methods, Statistical properties of conventional estimators, Parametric methods for higher-order spectrum estimation – MA, Noncausal AR and ARMA methods, Cepstra of higher-order spectra – Complex and differential cepstra, Bicepstrum, Cepstrum of the power spectrum.

8. **Wavelet Transform:** Windowed Fourier transform and Wavelet transform, Wavelet transform – Real wavelets, Analytic wavelets and Discrete wavelets, Instantaneous frequency, Frame theory, Windowed Fourier frames and wavelet frames, Dyadic wavelet transform, Orthogonal wavelet bases, Wavelets and filter banks, Biorthogonal wavelet

bases, Multiscale interpolations, Separable wavelet bases, Wavelet packets, Block transforms, Local cosine trees, Approximation – Linear versus nonlinear, Image approximation, Estimation – Bayes versus minimax, Restoration, Coherent estimation, Spectrum estimation.

Books Recommended:

Text Books:

1. Digital Signal Processing: Principles, Algorithms and Applications, Fourth Edition, Prentice-Hall : J.G. Proakis and D.G. Manolakis
2. Algorithms for Statistical Signal Processing, Prentice-Hall : J.G. Proakis, C.M. Rader et al
3. A Wavelet Tour of Signal Processing Second Edition, Academic Press : S. Mallat

APEE M 1 103

Advanced Biomedical Instrumentation

75 marks 3 credits 45 lectures

(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Audiometry:** Mechanism of Hearing, Hearing loss, Sound conduction system, Basic audiometer - Pure tone audiometer, Audiometer system-Bekesy - Evoked response audiometer system, Hearing aids.

2. **Ophthalmological equipments:** Anatomy of Eye, Visual acuity, Errors in vision, slit lamp, Tonometer, Ophthalmoscope, Perimeter.

3. **Respiratory Instrumentation:** Natural Process of Breathing, O2 and CO2 Transport, Regulation of Breathing, Spirometers, airflow measurement, Oxygenators-Bubble Type, Membrane Type, Ventilators.

4. **Blood gas analyzers and oximeters:** Blood pH measurement- Blood pCO2 measurement- Blood pO2 measurement- intra arterial - complete blood gas analyzer – Oximetry - Principle, ear, pulse, skin reflectance, intravascular oximeter.

Section – B

5. **Digital radiography (DR) and computed radiography (CR):** Digital Radiography – Basic principle, Flat panel detectors, Types and functions, Image quality. Computed radiography -Charged-Coupled devices (CCDs), Imaging using X-ray contrast agent for GI tract and Iodine based contrast agent, Applications.

6. **Digital fluoroscopy:** Fluoroscopy-imaging chain components-fluoroscopic detector systems automatic exposure rate control-fluoroscopy modes of operation-image quality-radiation dose, Applications.

7. **Digital subtraction angiography:** Basic of digital angiography - Image processors for digital angiography processor architecture, Temporal integration techniques for digital angiography, digital subtraction angiography.

8. **Emission tomography and applications:** Nuclear Imaging Emission Tomography: Focal plane tomography, Single photon emission computed tomography (SPECT), image acquisition, Image reconstruction, attenuation correction in SPECT, Positron emission tomography – Design and principles of operation, 2-D and 3-D acquisition.

Books recommended:

Text Books:

1. Handbok of biomedical Instrumentatio : R. S. Khandpur
2. Biophysics concept and mechanism : C. J. Casey
3. Introduction to Biomedical equipment technology : Joseph J Carr & John M. Brown
4. Medical Instrumentation : John G Webster
5. Medical Physics : J. G. Skofronick
6. Physical principles of medical imaging : Sprawls

APEE M 1 104

Renewable Energy, Conversion and Storage

50 marks 2 credits 30 lectures

(Time: 2 hrs; 2 *out of 3 questions to be answered from each section*)

Section – A

1. **Hydrogen and Fuel Cells:** Basics of electrochemistry, Fossil fuels and environmental impact, Polymer membrane electrolyte (PEM) fuel cells, Solid oxide fuel cells (SOFCs), Hydrogen production and storage, Coal-fired plants and integrated gassifier fuel cell (IGFC) systems.

2. **Solar Energy:** Solar radiation, Solar thermal energy, Photovoltaics (Solar cells), CO2 capture and solar fuels.

Section – B

3. **Biomass and Bio-energy:** Synthetic fuels from the biomass, Thermo-chemical, physical-chemical and bio-chemical conversion, Bio-fuel cells.

4. **Wind Energy and Hydroelectricity:** Availability of wind energy, Wind turbines, wind parks and power control, Water sources and power, Water turbines and hydroelectric plants, Energy storage.

Books Recommended:
Text Books:

1. Renewable Energy, Power for a Sustainable Future, Oxford University Press, 2004, ISBN-13: 978-0199261789 : Godfrey Boyle
2. Advanced Renewable Energy Sources, Royal Society of Chemistry, 2011 : G. N. Tiwari and R. K. Mishra
3. Renewable Energy: Physics, Engineering, Environmental Impacts, Economics & Planning, 2010 : Bent Sorensen

APEE M 2 105
Advanced Communication Engineering
100 marks 4 credits 60 lectures
(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Wireless Communication system:** 2G, 2.5G, 3G, 4G & 5G of wireless networks, GSM, WiMAX, WiFi; Wireless local loop and LMDS; Multiple access, FDMA, TDMA, CDMA, WCDMA, SDMA; Wireless system & standards.

2. **Cellular Concept-system design fundamentals**: Introduction, frequency reuse; Channel assignment and handoff strategies, Interference and system capacity; Power control for reducing interference; Trunking & GoS; Improving coverage & capacity in cellular system; Digital cellular system; Global System for Mobile (GSM); North American TDMA and CDMA.

3. **Radio propagation model**: Free space propagation model, Diffraction model, Log-distance path-loss model,, Hata-Okumma model, PCS micro cell model, Indoor propagation models; Small-signal fading and multipath propagation; Types of small-scale fading, Fading effect due to multipath, Time delay spread and Doppler spread; Rayleigh and Rician distributions.

4. **Equalization, Diversity & Channel coding:** Fundamentals of equalization, Equalization in communication receiver, Algorithm for adaptive equalization, Diversity technique, Channel coding, RAKE receiver, Block codes, Convolution codes.

Section – B

5. **Modulation techniques for Communications:** Introduction to digital communication, pulse modulation, Sampling and multiplexing; Digital modulation, BPSK, DPSK, QPSK, QPSK transmission and detection techniques; System noise; Spread spectrum modulation techniques.
6. **Baseband Transmission:** Introduction, Baseband center point detection, Error accumulation over multiple hops, Line coding, Multiplex telephony, Digital signal regeneration, Symbol timing recovery, Repeater design.
7. **Information theory and source coding:** Information and entropy, Conditional entropy and redundancy, Information loss due to noise, Source coding, Variable length coding, Source coding examples.

8. **Error control coding:** Introduction, Hamming distance and code word weight, (n, k) Block codes, Encoding of conventional codes, Practical coders.

Books Recommended:
Text Books:

1. Wireless Communications : Theodore S. Rappaport
2. Digital Communications : Ian Glover, Peter Grant, Prentice-Hall Inc.

Reference Books:

1. Principles of wireless networks : Kaveh Pahlavan & Prasant Krishnamurty
2. Wireless Communication : Andrea Goldsmith
3. Mobile Cellular Telecommunication : William C. Y. Lee

APEE M 2 106
VLSI Design
100 marks 4 credits 60 lectures
(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Digital Systems and VLSI:** Design integrated circuits. Integrated circuit Manufacturing. CMOS technology. Integrated circuit Design techniques. A look into the future.

2. **Transistors and Layout.:** Fabrication processes. Transistors. Wires and Vias. Design rules. Layout design and tools.

3. **Logic Gates:** Combinational logic functions, Static complementary gates, Wires and delay, Switch logic, Alternative gate circuits.

4. **Combinational Logic Networks:** Layout design methods. Simulation. Combinational network delay. Crosstalk, Power optimization. Switch logic networks. Combinational logic testing.

Section – B

5. **Sequential Machines:** Latches and Flip-Flops. Sequential systems and clocking disciplines. Sequential system design. Power optimization. Design validation. Sequential testing.

6. **Subsystem Design:** Subsystem design principles. Combinational shifters. Adders. ALUs. Multipliers. High-density memory. Field-Programmable Gate Arrays: Internal architecture, Design implementation using HD; Programmable Logic Arrays.

7. **Floor Planning:** Floor planning methods. Floor planning large chips. Off-chip connections.

8. **Introduction to HDL:** Hardware Description Language, Verilog and VHDL: History, Code structure; Design flow, Introduction to VHDL: Data types, Operators, Signal, Concurrency, Circuit simulation, Test Bench; Introduction to Xilinx ISE software suit.

Books Recommended:
Text Books:
1. Modern VLSI Design - Systems on Chip : Wayne Wolf

Reference Books:
1. Circuit Design and Simulation with VHDL : Volnei A. Pedroni
2. Principles of CMOS VLSI Design : Weste & Eshraghian
3. FPGA Prototyping by VHDL Examples : Pong P. CHU

APEE M 2 107
Environmental Geophysics
100 marks 4 credits 60 lectures
(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Introduction:** Meaning, scope and interdisciplinary nature of environmental science, Environmental factors, Human and global environment, Environmental stresses-causes, classifications and impacts, Global environmental issues, Environmental impact assessment.

2. **Material Balance:** Definition of systems, key elements and functions, mass balance equations, estimation of parameters and analysis; Modeling –types and classifications, parameter selection, model calibration and verification.

3. **Atmosphere:** Structure and composition of atmosphere; Physical and chemical fundamentals of air; Solar radiation, earth-atmosphere radiation balance, solar UV and life, ozone filter.

4. **Air Pollution:** Definition-local, regional and global aspects; Types and sources of air pollutants, transport mechanism; Air pollution effects on human and meteorology; Greenhouse effects; Analysis of air pollutants, air quality standards and pollution indices; Air pollution control methods.

Section – B

5. **Hydrosphere:** Definition, inventory of earth's water, global water balance; Hydrologic cycle- elements and characteristics; Flow of surface and subsurface water, Darcy's law; Distribution of subsurface water, groundwater and wells.

6. **Water Pollution:** Water pollutants-their types and sources, consequences of water pollution, major dissolved constituents in groundwater, geochemical data presentation, water quality and criteria; Treatment process of water and waste water-natural and engineering system.

7. **Noise:** Nature of sound, basic properties of noise-sound pressure, power and intensity, levels and decibels; Types and sources of noise, its propagation and attenuation, human perception and noise criteria; Effects of noise pollution; Noise scale and rating methods; Active control of noise pollution.

8. **Radiation:** Radioactivity and radiation, types and sources of radiation, radiation dose; Biological effects of ionizing radiation-short term, long term and genetic effects; Reduction of internal and external radiation hazards; Radioactive waste managements; Application of ionizing isotopes in waste water and air pollution treatment.

Books Recommended:
Text Books:
1. Introduction to Environmental Engineering : M.L Davis and D.A. Cornwell
2. Environmental Engineering : J .L. Sehnoor
3. Air Pollution : M. N. Rao and H. V. N. Rao
4. Groundwater Assessment : K. P. Karanth

Reference Books:
1. Principles of Environmental Science & Technology : K. Saravanan, S. Ramachandran and R. Baskar
2. Introduction to Environmental Engineering and Science : Gilbert M. Masters
3. Environmental Engineering : H. S. Peavy, D. R. Rowe and G. Tchobanoglous

APEE M 2 108
Advanced Computer Networking
50 marks 2 credits 30 lectures
(Time: 2 hrs; 2 *out of 3 questions to be answered from each section*)

Section - A

1. **Network Fundamentals and Internet overview:** Network Architecture; Performance; Network Elements; Ethernet (802.3), Rings (802.5, FDDI, RPR),

Wireless (Bluethooth, Wi-MAX, Wi-Fi, Cell Phone Technologies); Simple Internetworking (IP); Router Architecture; Routing Algorithms.

2. **Internetworking:** Protocols: RIP, OSPF, BGP, Metrics; Routing for Mobile Hosts; Global Internet; Subnetting: CIDR, VLSM, BGP; IPv6 details; Multicast; Multiprotocol Level Switching; Multiplexing and Demultiplexing; UDP, TCP, RPC, Transport for Real Time (RTP) Protocol.

Section - B

3. **Congestion Control and Resource Allocation:**Issues in Resource Allocation; Queuing Disciplines: FIFO, Fair Queue; TCP Congestion Control; Congestion-Avoidance Mechanisms; Quality of Service: Application Requirements, Integrated Services (RSVP), Differentiated Services (EF, AF), Equation-Based Congestion Control.

4. **Advanced Issues:** Overlay Networks: Routing overlay, Peer-to-peer network, Content Distribution Network; Network Virtualization; Datacenter and Cloud; Ubiquitous network; Software Defined network.

Books recommended:

Text Books:

1. Computer Networks - A Systems Approach, Fourth Edition : Larry L. Peterson & Bruce S. Davies
2. Computer Networking - A Top-Down Approach, Sixth Edition : James F. Kurose and Keith W. Ross
3. Computer Networks, Fourth Edition : Andrew S. Tanenbaum

Reference Books:

1. Computer Networking : Principles, Protocols and Practice, The Saylor Foundation : Olivier Bonaventure
2. A Practical Guide to Advanced Networking : Jeffrey S. Beasley and Piyasat Nilkaew, Pearson
3. Published Research Papers Recommended by the course teachers :
4. Optical Interconnects for Future Data Center Networks, ISBN: 978-1-4614-4629-3 (Print) 978-1-4614-4630-9 (Online) : Christoforos Kachris, Keren Bergman, Ioannis Tomkos

APEE M 3 109

Condensed Matter Physics

50 marks 2 credits 30 lectures

(Time: 2 hrs; 2 *out of 3 questions to be answered from each section*)

Section – A

1. **Fermi Surface & Metals:** Reduced zone Scheme, Periodic Zone Scheme, Construction of Fermi surface; Calculation of Energy bands, Deep Level Transient spectroscopy (DLTS), De Haas-Van Alphen effect, Nearly free electron approximation, Tight binding method, Wigner-Seitz method. Pseudo potential method.

2. **Plasmons, Polaritons and Polarons:** Plasma optics, Plasmons, Electrostatic Screening Mott. Metal Insulator transition, Polaritons, Fermi liquid, Polarons.

Section – B

3. **Magnetic Resonance:** Nuclear Magnetic resonance, Line width Hyperfine Splitting; Nuclear quadruple resonance; Electron paramagnetic resonance, Ferromagnetic resonance; Antiferromagnetic resonance.

4. **Spin Electronics:** Introduction, Technical basis of spin electronics, Spin injection, Giant magneto resistance (GMR), Tunneling magneto resistance (TMR), Spintronic devices and applications: Spin transistor.

Books recommended:

Text Books:

1. Introduction to Solid State Physics : Charles Kittel
2. Introduction to Superconductivity and High-Tc Materials : Michel Cyrot and Davor Pavuna

References Books:

1. Solid State Physics : A.J. Dekker
2. Electronic Process of in Materials : L Azaroff and J. Brophy
3. Fundamental of Solid State Physics : B.S. Saxena, R.C. Gupta & P.N. Saxena
4. Material Science for Engineers : L. H. Van Vlack
5. Materials Science : J.L. Anderson, R.D. Leaver, J. H. Alexander & R.D. Rawlings

APEE M 3 110

Nanoscience and Nanotechnology

100 marks 4 credits 60 lectures

(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Introduction:** Concepts of nanoscience and nanotechnology, Quantum mechanical aspects, Statistical mechanics and chemical kinetics.
2. **Microscopy and Manipulation Tools:**- Microstructural Features, Transmission Electron Microscopy, Scanning Electron Microscopy, Microanalysis in Electron Microscopy, Scanning Probe Microscopy and Related Techniques, nanomeasurements- based on fluorescence, Chemical Analysis of Surface Composition.

3. **Making Nanostructures- Top Down:**- Overview of nanofabrication-top down, photolithography, Electron beam lithography, thin film technologies, molecular beam epitaxy, self-assembled masks, focus ion beam milling, stamp technology, nanoscale junctions.

4. **Making Nanostructures- Bottom Up:**- Common aspects of all bottom-up assembly methods, organic synthesis, weak interfaces between molecules, vesicles and micelles, thermodynamic aspects of self-assembling nanostructures, a self-assembled nanochemistry machine-mitochondrion, self-assembled molecular monolayers, kinetic control of growth, DNA nanotechnology.

Section - B

5. **Electrons in Nanostructures:** - The vast variation in the lectronic properties of metarials, Electrons in nanostructures and quantum effects, Fermi liquids and free electron models, Electrons in 3D, Electrons passing through tiny structures, charging nanostructures: the coloumb blockade, Single electron transistor, resonant tunneling, Electron localization.
6. **Quantum Dots and Nanocomposites:** Germanium Self-assembled Quantum Dots on Silicon and Their Optoelectronic Devices, The Size Control and Patterning of Nanocrystalline Silicon Quantum Dots, Modeling of Quantum Dot Self-Assembly, Modeling of Electrostatically Gated Vertical Quantum Dots, Intersublevel Quantum-Dot Infrared Photodetectors, Nanocomposites and their applications.

7. **Carbon Nanotubes And Graphenes:** Structures and Properties of Carbon Nanotubes and Nano-Graphene, The Electronic Structure of Epitaxial Graphene, Growth of carbon nanotubes by Arc Discharge and Laser Ablation Techniques, Metallic and Semiconducting Carbon Nanotubes, Templated Carbon Nanotubes and the Use of their Cavities for Nanomaterial Synthesis , Carbon Nanotube Field Emission Electron and X-Ray Technology , Structural, Electronic, Magnetic, and Transport Properties of Carbon-Fullerene Based Polymers, Applications of SWNTs and MWNTs.

8. **Nano Magnetic Materials:** Few-Electron Quantum Dot Spintronics, Spintronics with Metallic Nanowires, Molecular Nanomagnets: Towards Molecular Spintronics, Magnetic Nanomaterials as MRI Contrast Agents , Magnetic Nanoparticles for Cancer Imaging and Therapy , Magnetic Nanomaterials for Environmental Applications, Characterization of Magnetic Nanoparticles using Magnetic Force Microscopy.

Books Recommended:

Text Books:

1.	Introduction to Nanoscience	:	S.M. Lindsay
2.	The Oxford Handbook of Nanoscience and Technology	:	A.V. Narlikar and Y.Y. Fu
3.	Handbook of Semiconductor Nanostructures	:	A. A. Balandin and K. L. Wang
4.	Carbon Nanotubes: Science and Applications	:	M. Meyyapagan
5.	Magnetic Nanomaterials	:	Challa S. S. R. Kumar

References Books:

1.	Science at the Nanoscale: An Introductory Textbook	:	Wee Shong Chin, Chorng Haur Sow and Andrew T S Wee
2.	Introduction to Nanoscience, Engineering and Technology	:	Massimiliano Di Ventra
3.	Introduction to Nanoscience	:	Gabor L. Hornyak; Joydeep Dutta; H.F. Tibbals; Anil Rao
4.	Microstructural Characterization of Materials	:	David Brandon, Wayne D. Kaplan
5.	Nanomaterials Handbook	:	Yury Gogotsi

APEE M 3 111

Thin Film Technology and Computational Materials

100 marks 4 credits 60 lectures

(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Thin Film Preparation Techniques:** Thermal evaporation, Evaporation theory and mechanism, E-beam evaporation, Sputtering, Plasma and Ion bean Sputtering, Sputtering yields, MBE, Chemical Vapor Deposition, Spray pyrolysis, Sol-gel technique.

2. **Growth and Structure of Thin Films:** Thermodynamics of Nucleation, Atomistic Theory of Nucleation, Coalescence, Influence of deposition parameters, Crystallographic structure of Thin Films, Epitaxial-growth phenomena, Structural defects in Thin Films.

3. **Thickness measurements & Analytical Techniques:** Electrical methods; Mechanical methods; Optical interference method; Analytical techniques, Chemical analysis, Structural analysis, Surface structure optical methods; Low energy electron interaction (LEEI) Auger electron spectroscopy, X-ray diffraction.

4. **Transport Phenomena in Thin Films:** Electrical conduction in discontinuous & continuous films. Temperature effect, Field effect, Hall effect, Thermoelectric power, Quantum size effect, Activation process, Optical absorption, transmission, reflection, Photoconductive mechanisms, Field effect, modified effects, Schottky effect, Poole-Frenkel effect, Tunneling & space charge limited Conduction.

Section – B

5. **Band Structure Calculations:** Introduction, Tight binding Approximation, LCAO method, Wannier functions, Cellular method, Orthogonal Plane-Wave Method, Pseudopotentials, Muffin-Tin potential, Augmented Plane-wave method, Electrons in a weak periodic potential, Reduced zone Scheme, Periodic Zone Scheme, Brillouin zones, Fermi surface.

6. **Density Functional Theory:** Foundations, the Hohenberg-Kohn theorems, Functionals for exchange and correlation, Local density approximation, DFT calculation for simple solid. Reciprocal space and K points, Energy cut-offs, Geometry optimization, Supercell, Optimization of Supercell.

7. **Electronic Structure and Magnetic Properties:** Electronic Density of States, Local density of states and atomic charges, magnetism, Magnetic dipolar interaction, Exchange interaction, Origin of exchange.

Books Recommended:

Text Books:

1. Thin Film Phenomena : K.L. Chopra
2. Hand Book of Thin Films Technology : Maissel and Glang
3. Thin Film Technology : C. G. Gavanqirst and G. A. Niklassons
4. Handbook of Physical Vapor Deposition : D.M. Mattox
5. Solid State Physics : N.W. Ashcroft and N.D. Mermin
6. Density Functional Theory: A Practical Introduction : D. S. Sholl
7. Introduction to Solid State Physics : C. Kittel
8. Electronic Structure, Basic Theory and Practical Methods : R. M. Martin

APEE M 3 112

Wireless Communication and Networking

100 marks 4 credits 60 lectures

(Time: 3 hrs; 3 out of 4 questions to be answered from each section)

Section - A

1. **Massive MIMO**: Introduction, challenges in hardware implementation and signal processing, Different Types of Massive MIMO, Mutual Information for Massive MIMO Uplink, Precoding Designs for Massive MIMO Downlink, Massive MIMO Channel Measurement Campaigns.

2. **Free Space Optical communication:** Introduction , OOK and 16-PPM modulations, Subcarrier intensity modulation(SIM) , comparison of modulation Techniques, Transmitter and receiver of SIM-FSO, turbulence induced channel fading.

3. **Cognitive radio system:** Introduction, applications of Cognitive Radio, Cognitive radio in the cellular world, complete cognitive radio system perspective, Cognitive radio platforms: digital hardware, antenna for Cognitive radio system, Spectrum authorization, Spectrum monitoring and compliance.

4. **Vehicular Communication**: Overview of Vehicular Communication, Bidirectional Communication Regime , Position Based Communication Regime Multi-Hop Position Based Communication Regime, Information in the Vehicular Network, Routing Protocols: Ad Hoc on Demand Distance Vector (AODV), Grid Location Service (GLS), Greedy Perimeter Stateless Routing (GPSR), Geographic Source Routing (GSR), Contention-Based Forwarding (CBF) Advanced Greedy Forwarding (AGF).

Section-B

5. **Wireless Application Protocol:** Introduction, WAP and the World Wide Web (WWW), Introduction to Wireless Application Protocol, The WAP Programming Model, WAP Architecture, Traditional WAP Networking Environment, WAP Advantages and Disadvantages, Applications of WAP, imode, imode versus WAP.

6. **Security in Wireless Systems:** Security and Privacy Needs of a Wireless System; Required Features for a Secured Wireless Communications System, Methods of Providing Privacy and Security in Wireless Systems, Wireless Security and Standards, IEEE 802.11 Security, Security in North American Cellular/PCS Systems, Security in GSM, GPRS, and UMTS, Data Security, Air Interface Support for Authentication Methods, Security in Current Wireless Systems.

7. **Wireless Personal Area Network:** Introduction, Bluetooth (IEEE 802.15.1) Bluetooth Protocol Stack, Bluetooth Link Types, Bluetooth Security, Network Connection Establishment in Bluetooth, Bluetooth Applications, Wireless Sensor Network: Usage, Model, Protocol Stack, ZigBee Technology, IEEE 802.15.4 LR-WPAN and IEEE 802.15.3a.

8. **Wireless Local Area Networks:** WLAN Equipment, Topologies, Technologies; IEEE 802.11 WLAN; Joining an Existing Basic Service Set, Security of IEEE 802.11 Systems, Power Management, IEEE 802.11b — High Rate DSSS, IEEE 802.11n;Other WLAN Standards; Interference between Bluetooth and IEEE 802.11; IEEE 802.16; World Interoperability for Micro Access (WiMAX): Physical Layer, Medium Access Control and Spectrum Allocation.

Books Recommended:

Text Book:

1.	MIMOProcessing for 4G and Beyond	:	Mário Marques da SilvaFrancisco A. Monteiro
2.	Optical Wireless Communications, System and Channel Modelling with MATLAB	:	Z. Ghassemlooy, W. Popoola and S. Rajbhandari
3.	Essentials of Cognitive Radio	:	Linda Doyle
4.	Vehicular-2-XCommunication	:	Radu Popescu-Zeletin, Ilja Radusch and Mihai Adrian Rigani
5.	Wireless Communications and Networking	:	Vijay K. Garg

Reference Book:

1.	Cognitive Radio networks, Architectures, Protocols, and Standards	:	Yan Zhangs, Jun Zhengs and Hsiao-Hwa Chen
2.	Large MIMO Systems	:	A. Chockalingam and B. Sundar Rajan
3.	Wireless Communications and Networks	:	William Stallings

APEE M 3 113

Network Security and Firewall

100 marks 4 credits 60 lectures

(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Internet Overview:** Basic internet primer, OSI and TCP/IP model, internet addressing, Internet working principle.

2. **Network Security Overview:** Fundamental Elements of Security, OSI security architecture, Basic Security Concepts, Common Security Threats, Assessing Vulnerability, Evaluating the Threats, Security Strategies.

3. **Encryption Techniques:** Classical techniques, Block cipher and DES, AES, Public Key cryptography and RSA. Key Management and Distribution, User authentication protocols.

4. **Network and Internet Security:** Transport level security, Wireless network security, Email Security, IP security, Intruders, Malicious software.

Section - B

5. **Firewall Overview:** The Origin and Need for Firewalls, Types of Firewalls, Constraints and Future Trends of Firewalls, Firewall Technologies: Packet Filtering, Proxy Servers, User Authentication, Network Address Translation, Virtual Private Networks.

6. **Firewall Architecture and Design:** Dial-Up Architecture, Single Router Architecture, Dual Router Architecture, Dual-Homed Host Architecture, Screened Host Architecture, Screened Subnet Architecture and its variations, Firewall Security Policy, Evaluating Firewalls, Firewall Configuration, Configuring a Packet-Filtering Architecture.

7. **Internet Services and Firewalls:** Web Servers, Securing Web Clients, HTTP Filtering Rules, Mail System Components, Securing E-Mail Messages, Filtering Rules for SMTP and POP, Accessing FTP Servers, Securing an FTP Server, Implementing Firewalls in Linux.

8. **Implementing Router-Based Firewalls:** An Introduction to Routers, Using Routers as Firewalls, Context-Based Access Control, CBAC Functions, Advantages of CBAC, Limitations of CBAC, How CBAC Works, Configuring CBAC. Recent research literature on network security.

Books Recommended:

Text Books:

1.	Cryptography and Network Security	:	William Stallings, Prentice Hall, NY, USA, 2006.
2.	Internet Security and Firewall	:	V.V Preetham, Premier Press, Ohio, USA, 2002

Reference Books:

1.	Network and System Security	:	John A. Vacca, Elsevier. 2010
2.	Network Security Assessment	:	Cris McNab, O'reilly Publisher

APEE M 3 114

Environmental Remote Sensing

100 marks 4 credits 60 lectures

(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Introduction:** Definition, Concepts and classifications of remote sensing; Physics of radiant energy, source and characteristics; Atmospheric interactions; Spectral characteristics of earth surface features.

2. **Satellites and Sensors:** Satellite systems-physical principles, orbital characteristics; Classifications of remote sensing satellites-earth resource satellites, meteorological

satellites; Sensor parameters and imaging systems; Data storage, dissemination and processing.

3. **Aerial Photography:** Fundamentals of photogrammetry, types of aerial photographs, geometric characteristics and scaling, image parallax, stereo photography, interpretation of photographs and images for environmental analysis.
4. **Image Analysis:** Elements of image interpretation; Digital image characters- processing, registration, enhancement techniques and classifications; Spatial filtering techniques; Image interpretation.

Section – B

5. **Microwave Remote Sensing:** Definition and principles, RADAR, SLAR, SAR; Geometrical characteristics, resolution; Interferometry, polarimetry; Processing and interpretation of SAR image.

6. **Thermal Remote Sensing:** Definitions and fundamentals; Radiation laws, sensing radiant temperature, black body radiation, radiation from real materials; Thermal sensors, characteristics of images and their uses.

7. **Global Positioning System:** Basic concept; Structure; Co-ordinate systems; Data processing; Error analysis; Accuracy enhancement; GPS receiver; Application; Communication; Navigation.

8. **Remote Sensing in Geosciences:** Measurement of image features; Remote sensing survey and mapping, litho logical discrimination, DEM; Resource mapping-agriculture, soil, forest, water, ocean; Monitoring-land use, atmospherical condition, snow, glacier; Environmental application; Airborne geophysical exploration.

Books Recommended:

Text Books:

1. Fundamentals of Remote Sensing : George Joseph
2. Fundamentals of Remote Sensing : Canada Center for Remote Sensing
3. Text book of Remote Sensing and Geographical Information Systems : M. Anji Reddy, BS Publications

APEE M 3 115

Disaster and Geoinformatics

100 marks 4 credits 60 lectures

(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Introduction:** Definition-hazards, .Earth structure, Vulnerability and risk, Natural and man-made hazards, Hazards due to dams and reservoirs, hazards due to nuclear power plants, industrial hazards, mitigation measures, warning system, forecasting, emergency preparedness, Education and training activities.

2. **Earthquake and Tsunami:** Earthquake-its causes and measurements, effects of earthquake and risk evaluation: Earthquake prediction, mitigation and control; Case history; Tsunami-its origin and nature, evaluation of Tsunami waves, local and distant impacts.

3. **Flood, Drought and Cyclones:** Flood-causes, nature and frequency of flooding, mass movement process, slope stability, stream theory, mitigation and environmental effects of flooding; Definition, identification, causes and impacts of drought; Cyclones-its nature and genesis, physical mechanisms for formation and intensification, life cycles, mitigation and environmental effects.

4. **Disaster Management:** Concept, disaster classification, preparedness measures, early warning system, post disaster environmental aspect study, resource mobilization; Natural disaster management framework in Bangladesh.

Section – B

5. **GIS Introduction:** Definition, concept, evolution and prospects of GIS; Components and functions of GIS; Map-classifications and scaling; Georeferencing-coordinate systems and projections, Spatial Data Operation, Concept, Data types, sources, accuracy, precision and resolution, Data base design methodology.

6. **Raster Data Analysis:** Characteristics of raster data processing, advantages and limitations of raster data, georeferencing of raster data; Local, neighborhood and regional operations of raster data; Raster GIS models.

7. **Vector Data Analysis:** Characteristics of vector data processing, Vector GIS models, comparison of raster and vector models; Measurement of area and distance; Thematic mapping; Buffering.

8. **Modeling in GIS:** Definition and types; Overview of GIS packages-Arc View, Arc GIS; Trend surface analysis; Terrain model.

Books Recommended:

Text Books:

1. Natural Disasters : Patrick L. Abbott
2. Earthquake, Tsunami and Geology of Bangladesh : A. A. Khan
3. Concept and Techniques of Geographic Information Systems : C. P. Lo and Albert K. W. Yeung
4. Text Book of Remote Sensing and Geographical Information Systems : M. Anji Reddy

Reference Books:

1. Environmental Hazards and Disasters : B. K. Paul
2. Principles of Geographic Systems : P. A. Burrough

APEE M 3 116
Image Processing and Pattern Recognition
100 marks 4 credits 60 lectures
(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Introduction:** Digital image, Steps in digital image processing, Components of an image processing system, Application of digital image processing, Image sampling and quantization, Basic relationships between pixels.
2. **Intensity Transformations and Spatial Filtering:** Basic concepts, Intensity transformation functions, Histogram processing, Mechanics of spatial filtering, spatial correlation and convolution.
3. **Filtering in the Frequency Domain:** Preliminary concepts, Extension to functions of two variables, Properties of 2-D DFT**,** Discrete cosine transform, Filtering fundamentals, Steps for filtering Image smoothing, Image sharpening, Image restoration, Noise models, Noise reduction, Inverse filtering, Wiener filter.

4. **Wavelets and Multiresolution Processing:** Background, Haar transform, Multiresolution expansions, Wavelet transforms.

Section – B

5. **Image compression:** Fundamentals of image compression, Coding redundancy, Spatial and temporal redundancy, image compression model, Huffman coding.

6. **Morphological Image Processing:** Erosion, Dilation, Opening, Closing, Basic morphological algorithms-Boundary extraction, Hole filling, Skeletons.

7. **Image Segmentation and Color Image Processing:** Basic concepts, Point, linc, and edge detection, Thresholding, Region-based segmentation, Color models, Color transformations.

8. **Pattern Recognition:** Patterns and pattern classes, Recognition based on decision-theoretic methods, Basic model of a neuron, Perceptron, Neural networks, Learning methods.

Books Recommended:
Text Books:
1. Digital Image Processing : Rafael C. Gonzalez, Richard E. Woods

Reference Books:
1. Image Processing, Analysis and Machine Vision : Millan Sonka, Vaclau Hlavac, Roger Boyle

APEE M 3 117
Speech Processing and Recognition
100 marks 4 credits 60 lectures
(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Introduction:** The speech chain, Speech sciences, Speech processing, Purpose of speech processing – coding, synthesis and recognition, Digital speech processing, Application of digital speech processing, Speech signal production/generation model, Speech perception model, Representations of speech, Phonemes and allophones, Vowels and consonants, Lombard reflex.

2. **Speech Production and Perception:** Human speech apparatus, Speech production model, Articulatory model, Human auditory system, Perception of sound – Loudness, Critical bands, Pitch and Auditory masking, Auditory models – Perceptual Linear Prediction (PLP) and Ensemble Interval Histogram (EIH) models.

3. **Speech Analysis (Fundamentals of Speech Analysis):** Steps of speech analysis, Preemphasis, Window functions, Short-term energy and zero-crossing rate, Short-term autocorrelation function (STACF), Short-term Fourier Transform (STFT), Speech spectrogram, Relation between STFT and STACF, Cepstrum and Complex Cepstrum, Application of Cepstrum, MFCC.
4. **Linear Prediction Analysis:** Linear prediction and the speech model, LP analysis methods – Covariance and autocorrelation methods, Levinson-Durbin algorithm, Frequency-domain interpretation of LP analysis, Effects of Model order, LPC Spectrum, LP Cepstral parameters, The Line Spectrum Pair (LSP).

Section - B

5. **Speech Coding and Synthesis:** Speech coding and synthesis system, Sampling and quantization of speech, Noise due to quantization, PCM, Adaptive PCM, Delta Modulation, Differential PCM, Adaptive Differential PCM, Vector quantization, LPC Vocoder, Speech coder comparisons.

6. **Speech Enhancement and Quality Assessment:** Classification of speech enhancement methods, Spectral subtraction, Wiener filtering, Enhancement and perceptual aspects of speech, The need for quality assessment, Quality versus Intelligibility, Subjective quality measures, Objective quality measures – Articulation index, SNR, Itakura Measure.

7. **Speech Recognition:** The speech recognition problem, Approaches to automatic speech recognition, Pattern comparison techniques, Dynamic time warping (Time alignment and normalization), Building a speech recognition system, Decision processes in ASR.

8. **Recognition using Hidden Markov Models:** Discrete-time Markov processes, Hidden Markov Models, Problems of HMM, Types of HMM, Continuous observation densities

in HMM, Autoregressive HMM, Optimization criterion, Implementation issues for HMM, HMM system for isolated word recognition, Coected word recognition, Large vocabulary continuous speech recognition.

Books Recommended:

Text Books:

1. Theory and Application of Digital Speech Processing, Prentice-Hall Inc., 2009 : L. R. Rabiner and R. W. Schafer
2. Fundamentals of Speech Recognition, Prentice-Hall Inc., 1993 : L. R. Rabiner and B. H. Juang

References Book:

1. Discrete-Time Processing of Speech Signals, Wiley-IEEE Press Reprint edition, 1999 : J. Deller, J. Hansen and J. Proakis

APEE M 3 118

Plasma Science and Technology

100 marks 4 credits 60 lectures

(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Gases:** Kinetic energy and Temperature, Mean Speed, Maxwell-Boltzmann Distribution, Pressure, Avogadro's Laws, Mean Free Path, Probability of Collision, Collision Frequency, Energy Transfer in Collisions, Gas Flow, Types of Gas Flow, Pumping Speed and Throughput, Gas Flow Rate and its measurements.

2. **Gas Phase Collision Processes:** Collision Cross Section, Elastic and Inelastic Collisions, Collision Processes, Ion Chemistry, Collision Cross-section, Plasma.

3. **Plasmas:** Electron and Ion Temperatures, Plasma Potential, Sheath Formation and Bohm Cirterion, Debye Shielding, Plasma Diagnostics: probe & spectroscopy, Sheath Formation, Plasma Oscillations, Ambipolar Diffusion.

4. **DC Glow Discharge:** Architecture of the Discharge, Maintenance of the Discharge, Secondary Electron Emission, Cathode Region, Anode region, Glow region, Plasma Sheath, Space Charge Limited Current, Electron Energy Distribution, Energy Dissipation in the Discharge, Energy Transfer amongst the Discharge Electrons.

Section -B

5. **RF Discharge:** Charging of Insulator Surfaces, Application of AC Discharges, Self-Bias, The Efficiency of Discharges, Sheaths-Collisions and Modulation, Matching Networks, Voltage Distribution, Application to Sputtering and Reactive Ion Etching Systems, Application to Planar Diode Reactors, Symmetrical Systems, Asymmetric Systems, Measurement of Plasma Potential, Equivalent Circuits, Plasmoids.

6. **Chemical Reactions and Chemical kinetics:** Introduction, Energy and Enthalpy, Entropy and Gibs free Energy ,Chemical Equilibrium, Elementary Reactions, Relation to Equilibrium Constant, Gas Phase Kinetics, First Order Consecutive Reactions, Opposing Reactions, Bimolecular Association with Photon Emission.

7. **Sputtering and Plasma Etching:** Interactions with Surfaces, Applications of Sputtering, Practical Aspects of Sputtering Systems, Plasma Ashing, Plasma Etching, Reactor Systems, Etching Mechanisms, Selective Etching and Plasma Polymerization, Chemical Dry Etching.

8. **Applications of Plasmas:** Lighting Systems, Display Technology, Environmental Application, Plasma Medicine, Textile Engineering, Sterilization, Thin Film Deposition, Coating, Surface Modification, Switch, Relay, Power System.

Books Recommended:

Text Books:

1. Glow Discharge Processes : Brian Chapman
2. Principles of Plasma Discharges and Materials Processing : M. A. Lieberman and A. J. Lichtenberg

APEE M 3 119

Plasma Technology for Hyperfunctional Surfaces

100 marks 4 credits 60 lectures

(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Introduction:** Plasma and Plasma Technology, Plasma Systems for Surface Treatment, Plasma-surface Interaction, Plasma types for textile processing, Plasma for materials processing.

2. **Anti-wear Coatings for Food Processing:** Introduction, Recent Developments in PVD Coatings, Coatings Application in the Food Processing Sector, Wear Resistance, Coefficient of Friction, Selection of Methodologies for Effective Characterization of Coatings for the Food Sector, Application to Anti-wear Coatings for Food Processing Tools.

3. **Preventing Biofilm Formation on Biomedical Surfaces:** Bacterial Adhesion to Biomaterials: Biofilm Formation, Biofilm Prevention Strategies, Role of Plasma Processing in Biofouling Prevention, Plasma-deposited Poly-like Films for the Prevention of Biofilm Formation.

4. **Plasma Medicine & Sterilization:** Plasma for medicine, plasma interaction with cell and living tissue, Surface microorganism inactivation, Plasma species and factors active for sterilization, physical and biochemical effects, Animal and human living tissue

sterilization, plasma sterilization of living tissues, deactivation of microorganisms, Plasma decontamination of water and air.

Section - B

5. **Textile Applications:** Plasma treatment of textiles, textiles for biomedical applications, plasma application to wool, Textile finishing performance, modification of cotton, interactions between plasmas and fibres, advantages and problems of plasma treatments for textiles, Industrial applications.

6. **Properties of plasma polymers:** Electronic structure, amorphous semiconductors, amorphous insulators, low and high conducting films, optical and optoelectronic properties, coating and films for optical devices, integrated optics, optoelectronic devices.

7. **Process Diagnostics:** Optical Emission Spectroscopy, OES Bench and Set-up, Optical Absorption Spectroscopy, Actinometry, X-ray Photoelectron Spectroscopy, Static Secondary Ion Mass Spectrometry, Atomic Force Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Contact Angle Measurement.

8. **Etching:** Etch Requirements and Processes, Plasma Etch Requirements, Halogen Atom Etching of Silicon, CF4 Discharges, F and CFx Etching of SiO2, Si3N4 Etching, Copper Etching, Resist Etching, Substrate Charging, Transient Damage During Etching, Electron Shading Effect, Radiofrequency Biasing, Etch Profile Distortions.

Books Recommended:

Text Books:

1.	Plasma Technology for Hyperfunctional Surfaces	:	Hubert Rauscher, Massimo Perucca and Guy Buyle
2.	Plasma Medicine	:	A. Fridman and G. Friedman
3.	Plasma Technologies for Textiles	:	R Shishoo
4.	Plasma Polymers	:	H. Biederman
5.	Principles of Plasma Discharges and Materials Processing	:	M. A. Lieberman and A. J. Lichtenberg

APEE M 3 120

Nuclear Engineering

100 marks 4 credits 60 lectures

(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Atomic and Nuclear Physics**: Fundamental Particles, Atomic and Nuclear Structure, Atomic and Molecular Weight, Atomic and Nuclear Radii, Mass and Energy, Particle Wavelengths, Excited States and Radiation, Nuclear Stability and Radioactive Decay, Radioactivity Calculations, Nuclear Reactions, Binding Energy, Nuclear Models, Gases, Liquids, and Solids.

2. **Interaction of Radiation with Matter:** Neutron Interactions, Cross-Sections, Neutron Attenuation, Neutron Flux, Neutron Cross-Section Data, Energy Loss in Scattering Collisions, Fission, y-Ray Interactions with Matter, Charged Particles 100 References 109 Problems.

3. **Nuclear Reactors and Nuclear Power:** The Fission Chain Reaction, Nuclear Reactor Fuels, Non-Nuclear Components of Nuclear Power Plants, Components of Nuclear Reactors, Power Reactors and Nuclear Steam Supply Systems, Nuclear Cycles, Isotope Separation, Fuel Reprocessing, Radioactive Waste Disposal.

4. **Neutron Diffusion and Moderation:** Neutron Flux, Fick's Law, The Equation of Continuity, The Diffusion Equation, Boundary Conditions, Solutions of the Diffusion Equation, The Diffusion Length, The Group-Diffusion Method, Thennal Neutron Diffusion, Two-Group Calculation of Neutron Moderation.

Section – B

5. **Nuclear Reactor Theory:** One-Group Reactor Equation, The Slab Reactor, Other Reactor Shapes, The One-Group Critical Equation, Thermal Reactors, Reflected Reactors, Multigroup Calculations, Heterogeneous Reactors.

6. **Heatremoval from Nuclear Reactors:** General Thennodynamic Considerations, Heat Generation in Reactors, Heat Flow by Conduction, Heat Transfer to Coolants, Boiling Heat Transfer, Thermal Design of a Reactor.

7. **Radiation Protection:** History of Radiation Effects, Radiation Units, Some Elementary Biology, The Biological Effects of Radiation, Quantitative Effects of Radiation on the Human Species, Calculations of Radiation Effects, Natural and Man-Made Radiation Sources, Standards of Radiation Protection, Computations of Exposure and Dose, Standards for Intake of Radionuclides, Exposure from y-Ray Sources.

8. **Radiation Shielding:** Gamma-Ray Shielding: Buildup Factors, Infinite Planar and Disc Sources, The Line Source, Internal Sources, Multilayered Shields, Nuclear Reactor Shielding: Principles of Reactor Shielding, Removal Cross-Sections, The Reactor Shield Design: Removal-Attenuation Calculations, The Removal-Diffusion Method, Exact Methods, Shielding y-Rays, Coolant Activation.

Books Recommended:

Text Book:

1.	Introduction to Nuclear Engineering (3rd edition), Prentice Hall	:	J. R. Lamarsh and Anthony Baratta.
2.	Fundamentals of Nuclear Science and Engineering, 2nd Edition, Taylor & Francis Group	:	J. K. Shults and R. E. Faw

APEE M 3 121
Nuclear Instrumentations
100 marks 4 credits 60 lectures
(Time: 3 hrs; 3 *out of 4 questions to be answered from each section*)

Section - A

1. **Temperature Detectors:** Temperature, Resistance Temperature Detector Construction, Thermocouple Construction, Thermocouple Operation, Functions of Temperature Detectors, Detector Problems, Environmental Concerns, Bridge Circuit Construction, Bridge Circuit Operation, Temperature Detection Circuit, Temperature Compensation.

2. **Pressure Detectors:** Bellows-Type Detectors, Bourdon Tube-Type Detectors, Pressure Detector Functions, Detector Failure, Environmental Concerns, Resistance-Type Transducers, Inductance-Type Transducers, Capacitive-Type Transducers, Detection Circuitry.

3. **Level Detectors:** Gauge Glass, Ball Float, Chain Float, Magnetic Bond Method, Conductivity Probe Method, Differential Pressure Level Detectors, Specific Volume, Reference Leg Temperature Considerations, Pressurizer Level Instruments, Steam Generator Level Instrument, Remote Indication, Environmental Concerns.

4. **Flow Detectors:** Orifice Plate, Venturi Tube, Dall Flow Tube, Pitot Tube, Area Flow Meter, Displacement Meter, Hot-Wire Anemometer, Electromagnetic Flowmeter, Ultrasonic Flow Equipment, Steam Flow Detection, Circuitry, Use of Flow Indication, Environmental Concern.

Section - B

5. **Position Indicators:** Synchro Equipment, Limit Switches, Reed Switches, Potentiometer, Linear Variable Differential Transformers (LVDT), Position Indication Circuitry Environmental Concerns.

6. **Radiation Detectors:** Radiation detection terminology, Electron-Ion Pair, Specific Ionization, Stopping Power Summary, Radiation types: Alpha Particle, Beta Particle, Gamma Ray, Neutron, Gas-filled detector: detector voltage, Applied Voltage, Proportional counter, Proportional Counter Circuitry, Ionization Chamber, Compensated Ion Chamber, Electroscope Ionization Chamber, Geiger-Müller Detector, Scintillation Counter, Gamma Spectroscopy.

7. **Miscellaneous Detectors:** Self-Powered Neutron Detector, Wide Range Fission Chamber, Activation Foils and Flux Wires, Photographic Film.

8. **Circuitry and Circuit Elements:** Terminology, Components, Source Range Nuclear Instrumentation, Intermediate Range Nuclear Instrumentation, Power Range Nuclear Instrumentation.

Books Recommended:
Text Book:

1. Instrumentation and Control, Volume 1, Department of Energy. (June 1992), Washington, DC.