CURRICULUM AND CREDIT FRAMEWORK FORUNDERGRADUATEPROGRAMME

SKILL ENHANCEMENT COURSES

Department of Physics

NAGALAND UNIVERSITY

2023

SKILLENHANCEMENTCOURSES(3CreditEach)

Skill EnhancementCourses (SEC)	Titleofthepaper	TotalCredit 3	Proposedby Department
	RenewableEnergyand EnergyHarvesting	3	
	WeatherForecasting	3	
	Radiationsafety	3	

PHYSICS–SEC-I
RENEWABLEENERGYANDENERGYHARVESTING

(Credits:03)

The aim of this course is not just to impart theoretical knowledge to the students but to provide themwithexposureandhands-onlearningwhereverpossible

Unit-1

FossilfuelsandAlternateSourcesofEnergy:
Fossilfuelsandnuclearenergy,theirlimitations,needofrenewableenergy,non-conventionalenergysources.AnoverviewofdevelopmentsinOffshoreWindEnergy, TidalEnergy,Waveenergysystems,OceanThermalEnergyConversion,solarenergy,biomass,biochemical conversion,biogasgeneration,geothermalenergytidalenergy,Hydroelectricity.

(6Lectures)

Solarenergy: Solarenergy,itsimportance,storageofsolar energy, solar pond, non-convectivesolar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solardistillation,solarcooker,solargreenhouses,solarcell,absorptionairconditioning.Needandcharacteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun trackingsystems.

(8Lectures)

Unit -2

WindEnergyharvesting
FundamentalsofWindenergy,WindTurbinesanddifferentelectricalmachinesinwindturbines,Powerelectronicinterfaces,andgridinterconnectiontopologies.

(4Lectures)

GeothermalEnergy: GeothermalResources,GeothermalTechnologies.

(3Lectures)

Unit-3

OceanEnergy
OceanEnergyPotentialagainstWindandSolar,WaveCharacteristicsandStatistics,WaveEnergyDevices.

(4Lectures)

TidecharacteristicsandStatistics,TideEnergyTechnologies,OceanThermalEnergy,OsmoticPower,Ocean Bio-mass.

(3Lectures)

Unit-4

HydroEnergy
Hydropowerresources,hydropowertechnologies,environmentalimpactofhydropowersources.

(3Lectures)

PiezoelectricEnergyharvesting: Introduction,Physics and characteristics of piezoelectric effect,materials and mathematical description of piezoelectricity, Piezoelectric parameters and modelingpiezoelectricgenerators,Piezoelectricenergyharvestingapplications,Humanpower.

(6Lectures)

Unit-5

ElectromagneticEnergyHarvesting

Lineargenerators,physicsmathematicalmodels,recentapplicationsCarbon

(3Lectures)

capturedtechnologies,cell,batteries,powerconsumptionEnvironmentaliss

(3Lectures)

uesandRenewablesourcesofenergy,sustainability.

(2Lectures)

DemonstrationsandExperiments

1. DemonstrationofTrainingmodulesonSolarenergy,windenergy,etc.
2. Conversionofvibrationtovoltageusingpiezoelectricmaterials
3. Conversionofthermalenergyintovoltageusingthermoelectricmodules.

Reference Books:

- Non-conventionalEnergySources,G.DRai,KhannaPublishers,NewDelhi
- SolarEnergy,MPAgarwal,SChandandCo.Ltd.
- SolarEnergy,SuhasPSukhative,TataMcGraw-HillPublishingCompanyLtd.
- RenewableEnergy,PowerforaSustainableFuture,GodfreyBoyle,2004,OxfordUniversityPress,inassociationwithTheOpenUniversity.
- SolarEnergy:ResourceAssessmentHandbook,Dr.PJayakumar,2009
- Photovoltaics,J.Balfour,M.ShawandS.Jarosek,LawrenceJGoodrich(USA).
- http://en.wikipedia.org/wiki/Renewable_energy

PHYSICS – SEC-II

RADIATION SAFETY

(Credits:03)

The aim of this course is for awareness and understanding regarding radiation hazards and safety.The list of laboratoryskillsandexperiments listedbelow the course are to be done in continuationofthetopics

Unit-1

BasicsofAtomicandNuclearPhysics:

Basicconcept ofatomic structure; X rays characteristicandproduction; concept of bremsstrahlungandaugerelectron,Thecompositionofnucleusanditsproperties,massnumber,isotopesofelements,spin, bindingenergy,stableand unstable isotopes,law ofradioactivedecay, Meanlifeandhalf-life,basicconceptofalpha,betaandgammadecay,conceptofcrosssectionandkinematicsofnuclearreactions, typesofnuclearreaction,Fusion,fission.

(9Lectures)

Unit-2

InteractionofRadiationwithmatter:

TypesofRadiation:Alpha,Beta,GammaandNeutronandtheir sources,sealedandunsealedsources, InteractionofPhotons-Photo-electriceffect,ComptonScattering,PairProduction,LinearandMassAttenuationCoefficients,
Interaction of Charged Particles: Heavy charged particles - Beth-Bloch Formula, Scaling laws, MassStoppingPower,Range,Straggling,ChannelingandCherenkovradiation.BetaParticles-Collisionand Radiationloss(Bremsstrahlung),
InteractionofNeutrons-Collision,slowingdownandModeration.

(10Lectures)

Unit-3

Radiationdetectionandmonitoringdevices:

RadiationQuantitiesandUnits:Basicideaofdifferentunitsofactivity,KERMA,exposure,absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake(ALI) andderivedAirConcentration(DAC).
Radiationdetection:Basicconcept and working principle of gas detectors, Ionization Chambers,ProportionalCounter,Multi-WireProportionalCounters(MWPC)andGiegerMullerCounter,ScintillationDetectors(InorganicandOrganicScintillators),SolidStates Detectors and NeutronDetectors,Thermoluminescent Dosimetry.

(10Lectures)

Unit-4

Radiationsafetymanagement

Biologicaleffectsofionizingradiation,Operationallimitsandbasicsofradiationhazardsevaluationandcontrol:radiation protection standards, International Commission on RadiologicalProtection (ICRP) principles, justification, optimization, limitation, introduction of safety and riskmanagementofradiation.Nuclear waste and disposal management. Brief idea about AcceleratordrivenSub-criticalsystem(ADS)forwastemanagement.

(8Lectures)

Unit-5

Applicationofnucleartechniques:

Applicationinmedicalscience(e.g.,MRI,PET,ProjectionImagingGammaCamera,radiationtherapy),Archaeology,Art,Crimedetection, Mining and oil. Industrial Uses*:* Tracing, Gauging,MaterialModification,Sterilization,Foodpreservation.

(8Lectures)

Experiments:

1. StudythebackgroundradiationlevelsusingRadiationmeter CharacteristicsofGeigerMuller(GM)Counter:
2. StudyofcharacteristicsofGMtubeanddeterminationofoperatingvoltageandplateaulengthusingbackgroundradiationassource(withoutcommercialsource).
3. StudyofcountingstatisticsusingbackgroundradiationusingGMcounter.
4. Studyofradiationinvariousmaterials(e.g.KSO4etc.).Investigationofpossibleradiationindifferentroutinematerialsbyoperating GMatoperatingvoltage.
5. StudyofabsorptionofbetaparticlesinAluminumusingGMcounter.
6. Detectionofaparticlesusingreferencesourceanddeterminingitshalflifeusingsparkcounter
7. GammaspectrumofGasLightmantle(SourceofThorium)

ReferenceBooks

- NuclearandParticlePhysics,W.E.BurchamandM.Jobes,Longman(1995)
- RadiationDetectionandMeasurements,G.F.Knoll
- ThermoluninescenseDosimetry,Mcknlay,A.F.,Bristol,AdamHilger(MedicalPhysicsHandbook 5)
- FundamentalPhysicsofRadiology,W.J.MeredithandJ.B.Massey,JohnWrightandSons,UK,1989.
- FundamentalsofRadiationDosimetry,J.R.Greening,MedicalPhysicsHandBookSeries,No.6,AdamHilgerLtd.,Bristol1981.
- PracticalApplicationsofRadioactivityandNuclearRadiations,G.C.LowentalandP.L.Airey, CambridgeUniversityPress,U.K., 2001
- AnIntroductiontoRadiationProtection,A.MartinandS.A.Harbisor,JohnWilley&Sons,Inc.New York,1981.
- NCRP,ICRP,ICRU,IAEA,AERBPublications.
- MedicalRadiationPhysics,W.R.Hendee,YearBook,MedicalPublishersInc.London,1981

PHYSICS – SEC-III
WEATHERFORECASTING

(Credits:03)

The aimof thiscourse is notjust to impart theoretical knowledge to the students but to enable themto develop an awareness and understanding regarding the causes and effects of different weatherphenomenonandbasicforecastingtechniques

Unit-1

Introductiontoatmosphere:

Elementary idea of atmosphere: physical structure and composition; compositional layering of theatmosphere;variationofpressureandtemperaturewithheight;airtemperature; requirements tomeasureairtemperature;temperaturesensors:types;atmosphericpressure:itsmeasurement;cyclonesandanticyclones:itscharacteristics.

(13Lectures)

Unit-2

Measuringtheweather:

Wind;forcesactingtoproducewind;windspeed direction: units, its direction; measuring windspeedand direction;humidity,clouds andrainfall, radiation:absorption, emissionand scattering intheatmosphere;radiationlaws.

(7Lectures)

Unit-3

Weathersystems:

Globalwindsystems;airmassesandfronts:classifications;jetstreams;localthunderstorms;tropicalcyclones:classification;tornadoes;hurricanes.

(7Lectures)

Unit-4

ClimateandClimateChange:

Climate:itsclassification;causesofclimatechange;globalwarminganditsoutcomes;airpollution;aerosols,ozonedepletion,acidrain,environmentalissuesrelatedtoclimate.

(7Lectures)

Unit-5

Basicsofweatherforecasting:

Weather forecasting: analysis and its historical background; need of measuring weather; types ofweatherforecasting;weatherforecastingmethods; criteria of choosing weather station; basics ofchoosingsiteandexposure;satellitesobservationsinweatherforecasting;weathermaps;uncertaintyandpredictability;probabilityforecasts.

(11Lectures)

DemonstrationsandExperiments:

1. Studyofsynopticchartsandweatherreports,workingprincipleofweatherstation.
2. Processingandanalysisofweatherdata:
    a. Tocalculatethesunniesttimeoftheyear.
    b. Tostudythevariationofrainfallamountandintensitybywinddirection.
    c. Toobservethesunniest/driestdayoftheweek.
    d. Toexaminethemaximumandminimumtemperaturethroughouttheyear.
    e. Toevaluatetherelativehumidityoftheday.
    f. Toexaminetherainfallamountmonthwise.
3. Exercisesinchartreading:Plottingofconstantpressurecharts,surfacescharts,upperwindcharts anditsanalysis.
4. Formatsandelementsindifferenttypesofweatherforecasts/warning(bothaviationandnonaviation)

Referencebooks:

- AviationMeteorology,I.C.Joshi,3rd edition2014,HimalayanBooks
- TheWeatherObserver'sHandBook,StephenBurt,2012,CambridgeUniversityPress.
- Meteorology,S.R.Ghadekar,2001,AgrometPublishers,Nagpur.
- TextBookofAgrometeorology,S.R.Ghadekar,2005,AgrometPublishers,Nagpur.
- WhytheWeather,CharlesFranklinBrooks,1924,Chapman&Hall,London.
- AtmosphereandOcean,JohnG.Harvey,1995,TheArtemisPress.
