(ग) कनिष्ठ अभियन्ता (यांत्रिक) (डिग्री)

परीक्षा की स्कीम

प्रश्न–पत्र	अंक	अधिकतम अंक	समय
भाग–अ :- सामान्य ज्ञान (राजस्थान का इतिहास, कला एवं संस्कृति, परम्पराऐं, विरासत एवं राजस्थान का भूगोल)	40	120 अंक	2 घण्टे
भाग–ब :- यांत्रिक अभियांत्रिकी(डिग्री)	80		

नोट :–

1. प्रश्न पत्र में बहुविकल्पीय प्रकार के प्रश्न होंगे व सभी प्रश्नों के अंक समान होंगे।
2. परीक्षा में न्यूनतम निर्धारित उत्तीर्णांक अंक 40 प्रतिशत है। इससें कम अंक प्राप्त करने वाले अभ्यर्थी नियुक्ति के लिए पात्र नहीं होगें।

पाठ्यक्रम (Syllabus)

भाग–अ :- सामान्य ज्ञान

राजस्थान का इतिहास, कला एवं संस्कृति, साहित्य, परम्पराऐं एवं विरासत

1. राजस्थान के इतिहास के प्रमुख स्रोत
2. राजस्थान की प्रमुख प्रागैतिहासिक सभ्यतायें
3. राजस्थान के प्रमुख राजवंश एवं उनकी उपलब्धियां
4. मुगल–राजपूत संबंध
5. स्थापत्य कला की प्रमुख विशेषताऐं
6. महत्वपूर्ण किले, स्मारक एवं संरचनाये
7. राजस्थान के धार्मिक आंदोलन एवं लोक देवी–देवताऐं
8. राजस्थान की प्रमुख चित्रकलाऐं, शैलियां एवं हस्तशिल्प
9. राजस्थानी भाषा एवं साहित्य की प्रमुख कृतियां, क्षेत्रीय बोलियां
10. मेले, त्यौहार, लोक संगीत, लोक नृत्य, वाद्ययंत्र एवं आभूषण
11. राजस्थानी संस्कृति, परंपरा एवं विरासत
12. महत्वपूर्ण ऐतिहासिक पर्यटन स्थल
13. राजस्थान के प्रमुख व्यक्तित्व
14. राजस्थान की रियासतें एवं ब्रिटिश संधियां, 1857 का जन–आंदोलन
15. कृषक एंव जन–जाति आंदोलन, प्रजामंडल आंदोलन
16. राजस्थान का एकीकरण
17. राजस्थान का राजनीतिक जनजागरण एंव विकास– महिलाओं के विशेष संदर्भ में

राजस्थान का भूगोल

1. स्थिति एवं विस्तार
2. मुख्य भौतिक विभाग :– मरूस्थलीय प्रदेश, अरावली पर्वतीय प्रदेश, मैदानी प्रदेश, पठारी प्रदेश
3. अपवाह तन्त्र
4. जलवायु
5. मृदा
6. प्राकृतिक वनस्पति
7. वन एवं वन्य जीव संरक्षण
8. पर्यावरणीय एवं पारिस्थितिकीय मुददे
9. मरूस्थलीकरण
10. कृषि–जलवायु प्रदेश एवं प्रमुख फसलें
11. पशुधन
12. बहुउद्देशीय परियोजनाऐं
13. सिंचाई परियोजनाऐं
14. जल संरक्षण
15. परिवहन
16. खनिज सम्पदाऐं

भाग–ब :- यांत्रिक अभियांत्रिकी (डिग्री)

1.Fluid Mechanics

Properties & Classification of Fluid : ideal & real fluids, Newton's law of viscosity, Newtonianand Non-Newtonian fluids, compressible and incompressible fluids.
Fluid Statics : Pressure at a point.
Measurement of Fluid Pressure : Manometers, U-tube, Inclined tube.
Fluid Kinematics : Stream line, laminar & turbulent flow, external & internal flow, continuity equation.
Dynamics of ideal fluids : Bernoulli's equation, Total head; Velocity head; Pressure head; Application of Bernoulli's equitation.
Measurement of Flow rate Basic Principles : Venturimeter, Pilot tube, Orifice meter.

2. Fluid Machine

HydraulicTurbines:Classificationofhydraulicturbines,workdoneandefficienciesofPelton,Francisand Kaplanturbines,Drafttube,Specificspeedandunitquantities.
Hydraulic systems: Hydraulic press, Hydraulic accumulator,HydraulicIntensifier, Hydraulic Ram, Hydraulic lift, Hydrauliccoupling,HydraulictorqueconvertorGearpump.

3. Design of Machine Components

Materials:MechanicalPropertiesandISCodingofvariousmaterials,Selectionofmaterialfromproperties andeconomicaspects.
Manufacturing Considerations in Design: Standardization,Interchangeability,limits,fitstolerancesandsurfaceroughness,BISCodes,Designconsiderationforcast,forgedandmachinedparts.Designforassembly.
Design for Strength: Modes of failure, Strength and Stiffnessconsiderations, Allowable stresses, factor of safety, Stressconcentration:causesandmitigation,fatiguefailures.
DesignofMemberssubjectedtodirectstress:pin,cotterandkeyedjoints.
DesignofMembersinBending:Beams,leversandlaminatedsprings.
Design for stiffness ofbeam:Useofmaximumdeflectionformulaforvariousendconditionsforbeamdesign.
DesignofMembersinTorsion
ShaftandKeys:Designforstrength,rigidity.Solidandhollowshafts.Shaftsundercombinedloading.Sunkkeys.
Couplings: Design of muff coupling, flanged couplings: rigid andFlexible.
DesignofThreaded fasteners:Boltofuniformstrength,Preloadingofbolts:Effectofinitialtensionandappliedloads,Eccentricloading.
Powerscrewslikeleadscrew,screwjack, Design ofmemberswhicharecurvedlikecranehook,body ofC-clamp,machineframeetc.
DesignofICEnginecomponents:Piston,Cylinder,ConnectingRodandCrankShaft.Designofhelicalcompression,tension,torsionalsprings,springsunder variablestresses.
Designofbelt,ropeandpulleydrivesystem,
Designofgearteeth:LewisandBuckinghamequations,wearand dynamicloadconsiderations.
Design andforce analysis of spur, helical, bevel andworm gears,
Bearingreactionsduetogeartoothforces.

4. Kinematic & Dynamics of Machines

Governors: Comparison between flywheel and governor, Types ofgovernor,Watt,Porter,Proell,Hartnellandspringcontrolledgovernors,sensitivenessofgovernors,stabilityofgovernors,isochronousandhunting,governoreffort,power,controllingforcediagram.
Gyroscope:Principleofgyroscopiccouple,effectofgyroscopiccoupleandcentrifugalforceonaeroplanes,shipsandvehicletakingaturn,stabilizationofseavessels,
stabilityoffourwheeledvehiclemovinginacurvedpath,curvedpathwithbanking,stabilityoftwowheeledvehicle,gyroscopiceffectoninclinedrotatingdisc.
Inertiaforceanalysis:Velocityandaccelerationofslidercrankandfourbarmechanism,inertiaforce,pistonthrustandforcesonconnectingrod,turningmomentdiagram,flywheel.
Gears:Classification,terminology,lawofgearing,velocityofsliding,geartoothprofile,comparisonofcycloidalandinvolutetoothprofile,standardinterchangeabletoothprofile, length ofpathof

contact,arcofcontact,
contactratio,interference,undercutting,minimumnumberofteethonpinionincontactwithgear orrack,bevel,helicalandspiralgears.
GearTrains:Simple,compound,revertedandepicyclicgeartrains,analytical,tabular,graphical andvectormethodsforfindingvelocityratio,gearboxes-
slidingandconstantmesh,synchromeshanddifferentialgearbox.
Balancing:Needofbalancing,Balancingofrotatingmasses,singleplane, different planes, balancing of reciprocating masses, singlecylinderengine,multi-cylinderinlineengines,V-engines,conceptofdirectand
reversecranks,partialbalancingoflocomotives,ICengines,Venginesandbalancingmachines.

5.Turbo machines

BasicConceptsofTurboMachines:Definition&classificationofTurbo machine, Basic laws and governing equations: continuityequation,steadyflowenergyequation(1stlawofthermodynamics),2ndlaw of thermodynamicsappliedtoturbo machines,
Newton's2ndlawofmotionappliedtoturbomachines-
Euler'spumpequationandEuler'sturbineequation
Dimensionalanalysisappliedtohydraulicmachines,powercoefficient,flowcoefficient,headcoeff icient,non-dimensional
specificspeed,Rangeofspecificspeedsforvariousturbomachines,Dimensionalanalysisappliedt ocompressibleflowmachines,pressureratioasaFunctionoftemperatureratio,massflowratepar ameterandspeedparameter
CentrifugalCompressorsandFans: Components and description,velocityiagrams,slipfactor,energytransfer,powerinputfactor,stagepressurerisean dloadingcoefficient,pressurecoefficient,degreeofreaction,Centrifugalcompressorcharacteristi c,surging,rotatingStallandChoking

AxialFlowCompressorsandFans:Basicconstructionalfeatures,Advantagesofaxialflowcompres sors,workingprinciple,velocitytriangle,elementarytheory,stagework,workdonefactor,stageloa ding,degreeofreaction;vortextheory,simpledesigncalculations,introductiontobladedesign,cas cadetest,compressibilityeffects,operatingcharacteristics

ReciprocatingCompressors:Basicconstructionalfeatures,workingprinciple,workdonecalculati on,singleanddoubleactingcompressors.
CentrifugalPumps:Mainparts,workdoneandvelocitytriangles,slipandslipfactor,pumplossesan defficiencies,minimumstartingspeed,netpositivesuctionhead,performancecurve.

AxialFlowPumps:Description,velocitytriangles,workdoneonthefluid,energytransfer,axialpum pcharacteristics,cavitation.
ReciprocatingPumps:Classification,componentandworking,singleactinganddoubleacting,dis charge,workdoneandpowerrequired,coefficientofdischarge,indicatordiagram,slip,effectoffrict ionandacceleration,theoryofairvessels.
Gaspowercycles:Idealand practicalgas
turbinecycle,heatexchangecycle,reheatcycle,intercooledcycle,Comparisonofvariouscycles.
ThermodynamicCycles:Advantages,disadvantagesandperformancecharacteristicsofRamjete ngine,pulsejetengine,turbopropengine,turbojetengine,turbofanengine,Calculationofspecifict hrustandefficiency

Gas Turbines: impulse and reaction type gas turbines,
Velocitytrianglesandcalculationofworkdone,efficiencyetc.

6. Auto Cad -Mechanical Engineering drawings

Review of sectioning, Review of BIS Standard (SP 46), Fasteners –
screws,boltsandnuts,rivetedjoints,pins,lockingdevices,weldedjoints,pipejoints,unionsandval ves.Assembliesinvolvingmachineelementslikeshafts,couplings,bearing,pulleys,gears,belts,br ackets.Tooldrawingsincludingjigsandfixtures.Enginemechanisms-
assemblyanddisassembly.Productiondrawings-
limits,fitsandtolerances,dimensionalandgeometrictolerances,surfacefinishsymbols.Layoutdr awings.Schematics,processandinstrumentationdiagrams,pipingdrawings.Structuraldrawins-

examplesforreadingandinterpretation.Computeraideddesignanduseofsoftwarepackagesforen gineeringdrawings.

AssemblyDrawingwithsectioningandbillofmaterialsUniversalCoupling,Formingpunchanddie ,Jigsforinspectingshaftetc.(1drawingsheetofanyassembly)Lathetailstock,shapertoolhead,ste amstopvalve,feedcheck-valve,swivelmachineviceetc(1drawingsheetofanyassembly).

Detailed part drawings from assembly drawing indicating fits,tolerancesandsurfacefinishsymbolsbyreferringBIScodes(1drawingsheet)Check-valve,JunctionValveetc.

ComputerAidedDrafting(4drawings)

Introduction,input,outputdevices,introductiontosoftwarelikeAutoCAD/ProE/Creo/Solidwork s,basiccommandsanddevelopmentof2Dand3Ddrawingsofsimpleparts.

FreeHandSketches: Connecting rod, crank shaft, Pipes and Pipefittings,machinearborandcutter,universaldividinghead,jigsandfixtures,Steplessdrive,sl idinggearbox,safetyvalve,threewaystopvalve,blow-offcock,Swivelbearing,TurretToolPost,drill-pressvice,screwjack.

7. Thermo Dynamics

PropertiesofPureSubstances:p-v&P-TdiagramsofpuresubstancelikeH_2O,Introductionof steamtablewithrespecttosteamgenerationprocess;definitionofsaturation,wet&superheated status.Definitionofdrynessfractionofsteam,degreeofsuperheatofsteam.h-schartofsteam (Mollier'sChart).

1st LawofThermodynamics:Definitionofstoredenergy&internalenergy,1st Lawof Thermodynamicsofcyclicprocess,NonFlowEnergy Equation,FlowEnergy&Definitionof Enthalpy,ConditionsforSteadyStateSteadyFlow;SteadyStateSteadyFlowEnergyEquation.

2nd LawofThermodynamics:DefinitionofSink,SourceReservoirofHeat,HeatEngine,Heat Pump&Refrigerator;ThermalEfficiencyofHeatEngines&co-efficientofperformanceof Refrigerators,Kelvin–Planck&ClausiusStatementsof2ndLawofThermodynamics,Absoluteor Thermodynamic Scale of temperature,ClausiusIntegral,Entropy,Entropychangecalculationofideal gasprocesses. CarnotCycle&CarnotEfficiency,PMM-2;definition&itsimpossibility.

AirstandardCyclesforICengines:Ottocycle;plotonP-V,T-SPlanes;ThermalEfficiency, DieselCycle;PlotonP-V, T-Splanes; Thermal efficiency.

8. Heat Transfer

Introduction: Heat transfer processes, conduction and radiation.Fourier'slawofheatconduction,thermalconductivity,thermalconductivityofsolids,li quidsandgases,effectoftemperatureonthermalconductivity.Newton'slawofcooling,definitionof overallheattransfercoefficient.Generalparametersinfluencethevalueofheattransfercoefficient .

Conduction:General3-Dimensoinalconduction equationinCartesian,cylindricalandsphericalcoordinates;differentkindsofboundarycondition s;natureofdifferentialequations;onedimensionalheatconductionwithandwithoutheatgenerati on;electricalanalogy;heatconductionthroughcompositewalls;criticalthicknessofinsulation

Heattransferfromextendedsurfaces:Governing differentialequationoffin,finefficiencyandeffectivenessfordifferentboundaryconditions.

Unsteadystateheatconductionforslab,cylinderandsphere,Heislerchart.

Convection: Review of Navier – Stokes and energy equation,hydrodynamicandthermalboundarylayers;laminarboundarylayerequations;forced convectionappropriatenondimensionalmembers;effectofPrandtlnumber;empiricalrelationsfo rflowoveraflatplateandflowthroughpipes.

Natural convection: Dimensional analysis, Grashoff number,boundarylayersinexternalflows(flowovera flatplateonly),boundarylayerequationsandtheirsolutions,heattransfercorrelations.

Heat transfer with change of phase: Nature of vaporizationphenomena;differentregimesofboilingheattransfer;correlationsforsaturatedliquidvaporization;condensationonflatplates;correlationofexperimentalresults,dropwisecondensation.

Heat exchanger: Types ofheat exchangers, arithmetic andlogarithmicmean temperature differences,heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness ofheat exchanger, N.T.U.method, fouling factor. Constructional andmanufacturing aspects of HeatExchangers.

ThermalRadiation: Plank distribution law, Krichoff slaw; radiationproperties, diffuse radiations;Lambert'slaw. Radiationintensity,heat exchange between two black bodiesheat exchanger betweengray bodies.Shape factor; electrical analogy; reradiating surfaces heat transferin presence of reradiating surfaces.

9. Mechanics of Solid

StressandStrain:Elementarydefinitionofstressandstrain,stress-strainrelationship,elastic,plasticandvisco-elasticbehaviorofcommonmaterialsintensionandcompressiontest,stress-straincurves,Hooke'slaw,Poisson'sratio,elasticconstantsandtheirrelationsforanisotropichookeanmaterial,anisotropicandorthotropicmaterials.

Tension,compression,shearingstressandstrain,thermalstresses,compositebars,equationsofstaticequilibrium,conceptoffreebodydiagram.Strainenergyduetoaxialloading.

MembersSubjectedtoFlexuralLoads:Theoryofsimplebending,bendingmomentandshearforcediagramsfordifferenttypesofstaticloadingandsupportconditionsonbeams.

bending stresses, section modulus and transverse shear stressdistributionincircular,hollowcircular,I,Box,T,anglesectionsetc.Strainenergyduetobending.

PrincipalPlanes,StressesandStrains:Memberssubjectedtocombinedaxial,bendingandtorsionalloads,maximumnormalandshearstresses,conceptofequivalentbendingandequivalenttwistingmoments,Mohr'scircleofstressandstrain.

TheoriesofElasticFailures:Thenecessityforatheory,differenttheories,significanceandcomparison,applications.

Torsion:Torsionalshearstressinsolid,hollowandsteppedcircularshafts,angulardeflectionandpowertransmissioncapacity.Strainenergyduetotorsionalloads.

StabilityofEquilibrium:Instabilityandelasticstability,longandshortcolumns,idealstrut,Euler's formulaforcripplingloadforcolumnsofdifferentends,conceptofequivalentlength,eccentricloading,Rankineformulaeandotherempiricalrelations.

TransverseDeflectionofBeams:Relationbetweendeflection,bendingmoment,shearforceandload,transversedeflectionofbeamsandshaftunderstaticloading,areamomentmethod,directintegrationmethod.

10. Machine Drawings