BITS, Pilani-Dubai Campus/1st semester, 2013-14

3rd year (EEE)/ Comprehensive Exam/ F.M =80(40%)/ Date —29/12//2013

Course Title ---Electric Power Utilization and Illumination

Course Code No.--EEE F427 / Duration—3 hrs. [Instruction: 1 H.P =735.5 watts]

1.)In context to "Cooling –Time Curve of motor", derive the expression for temperature-fall (ϑ′) as a function of time with detailed steps and meaning of all symbols used. --------[10 marks]

2.)The outside of a 12 h.p motor is equivalent to a cylinder of 65 cm. diameter and 1.0 metre length. The motor weighs 400Kg. and it has specific heat of 700 J/Kg/°C . Outer surface is capable of heat dissipation of 12.5 W/sq. m/°C . Calculate the "Final Temperature –rise" and "Heating Time Constant " (in hours) of the motor when operating at full load with an efficiency of 90% ---[6 marks] .

3.)A 250 volts D.C shunt motor with constant field excitation drives a load whose torque varies as square root of speed. The armature current is 20 amperes when motor is running at 500 r.p.m. Find the possible all values of armature current and speed of the motor when running with 25.0 ohm resistance connected in series with the armature. Should which value of speed be accepted and why? Neglect motor losses. Furthermore, prove mathematically that larger the speed will be , larger will be the efficiency of this motor- load combination. --------[6+1+3 marks]

4.) A train runs at an average speed of 50 kmph between two railway stations situated 2.5 km. apart. Acceleration and retardation of the train are 2 kmphps and 3kmphps, respectively. Calculate its maximum speed assuming simplified trapezoidal speed-time curve. Also find the distance travelled by the train before the brakes are applied. For finding the numerical answers , stepwise derivations are necessary (direct substitution of any formula will not be accepted). The speed –time curve also should be drawn with proper labeling.-----[7+3+2 marks]

5.)A 220 volts, 15 H.P d.c shunt motor with full load speed of 1000 r.p.m is to be braked by **PLUGGING.** Full load efficiency is 85% . Armature and field winding resistances are 0.2 Ω and 220.0 Ω, respectively.. Calculate the value of resistance which should be placed in series with the armature winding to limit the initial braking current to twice (2 times) the full load armature current. Also calculate the initial braking torque in N-m. ----[6+6 marks]----[P.T.O]

6.) With reference to the associated Fig.-1, derive the condition (in detail) for illumination at point "A" to be maximum, when the height(h) of the lamp (positioned at point "S") is varied.-----[10 marks]

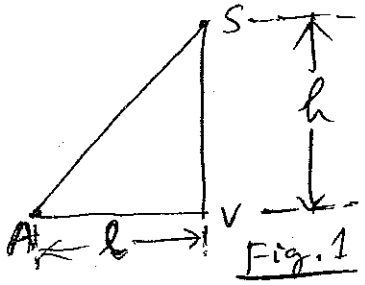

Fig. 1

7.(a) Derive the formula for Dielectric Power Loss (P) in terms of "tanδ", "A", "k_0", "k_r", "t", "V" and "f" , where the symbols have their usual meanings , in context to Dielectric Heating. Draw the necessary circuit diagram and phasor diagram also.

(b) A piece of insulating material is to be heated by dielectric heating. The size of the piece is 100 sq.cm and 2.5 cm. thick . A frequency of 25.0 MHz. is used and power absorbed is 350 watts. $K_0=(8.85)\times(10^{-12})$ F/m and k_r = 5 and power factor=0.05 .Calculate the voltage necessary for heating and also find out the current. Use the formula derived in Q. 7(a) OR the direct use of the formula is allowed.-------[6+5 marks]

8.) (a) Drawing a trapezoidal speed-time curve of a locomotive, derive the expression for maximum power (in H.P) , in terms of F_t(expressed in Kg.), V_m (in Km./hr.) and η (efficiency of transmission and gear) and other symbols have their usual meanings.

(b). With reference to Q.8 (a):--- F_t= 54.00 Kg, Duration of acceleration=10 seconds, α=4.7 Kmphps , η= 85%. Calculate maximum power(in HP) using the formula derived or it may directly be used.----------[5+4 marks]

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BITS, Pilani-Dubai

1st semester, 2013-14

3rd year(EEE)/ Test-2(Open Book)/ F.M =20 (20%)/Date of Test-2—10/11/2013(**Only text book and hand written class notes are allowed**)

Course Title ---Electric Power Utilization and Illumination

Course Code No.--EEE F427 / Duration—50 min.

1.) A single phase ,4-pole induction motor has data(rated): 220 volts,50 Hz,1425 r.p.m . It has also the parameters : stator main winding(only) resistance and leakage reactance --- 2.0 and 6.0 ohms ,respectively ; Rotor winding resistance and leakage reactance (referred to stator) --- 5.0 and 6.0 ohms, respectively; Magenetising reactance=60.0 ohms. It drives a fan load (whose torque varies as square of the speed) at rated speed when full voltage is applied . Calculate the electromagnetic torque(in Newton-metre) for a speed of 1200 r.p.m . --------[08 marks]

2.) Three phase identical balanced windings (120 electrical degree apart in space and same no. of turns)) distributed in slots , within a rotating electrical machine are considered. Those windings are excited from a D.C source (OR, one may assume that those windings are carrying same alternating currents of same phase). Prove (with detailed mathematical analysis) that the resultant system(for any of the above-said two cases) will not be able to produce any net electromagnetic torque. Any phase sequence in space may be assumed. --------[07 marks]

3.) A three phase, 6-pole , 50 Hz , 440 volts (L-L), star connected induction motor has following parameters (rotor parameters---referred to stator) in ohms per phase: R_s=0.5, $R'_r = 0.6$, $X_s = X'_r = 1.0$. Calculate the difference between the values for the " Slip for maximum torque in normal motoring mode" and the " Slip for maximum torque in regenerative braking mode" . State the assumptions , if any. --------[05 marks]

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BITS, Pilani-Dubai Campus

1st semester, 2013-14

3rd year (EEE)/ Test-1/ F.M =25 (25%)/ Date of Test-1—30/09/2013

Course Title ---Electric Power Utilization and Illumination

Course Code No.--EEE F427 / Duration—50 min.

1.) In context to "Heating –Time Curve of motor", derive the expression for temperature-rise (ɵ) as a function of time with detailed steps and meaning of all symbols used. --------[11 marks]

2.) A 250 volts D.C shunt motor with constant field excitation drives a load whose torque varies as speed. The armature current is 20 amperes when motor is running at 500 r.p.m. Find the speed of the motor when running with 25.0 ohm resistance connected in series with the armature. Neglect motor losses. --------[08 marks]

3.) A 6-pole 50 Hz. three phase Synchronous motor coupled to a load has moment of inertia of 300 kg.-m^2 . If frictional torque is 10.0 kg.-m , calculate the time taken by the motor to come to stop when a particular braking method is applied with an initial braking torque of 350 kg.-m . Use the concept of mechanics of braking. --------[06 marks]

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BITS, Pilani-Dubai Campus

1st semester, 2013-14

3rd year (EEE)/ Quiz-2/ F.M =14 (7%)/ Date of Quiz-2—05/12/2013/**Set-A**

Course Title ---Electric Power Utilization and Illumination

Course Code No.--EEE F427 / Duration—20 min. [Name/Id No.----]

MARKS----Q1—3/ Q2—4/ Q3—2/ Q4—1/ Q5—2/ Q6—2

1.) Lumen of a lamp= 1000; Transmission factor=0.7: C.P=55.73.----Calculate the solid angle

2.) Draw a horizontal polar curve (labeled) with its definition to be stated.

3.) Explain with diagram, the difference between "PLANE ANGLE" and "SOLID ANGLE".

4.) " Lumens= (Luminous Intensity)/(Solid Angle)"--- Is this statement TRUE or FALSE ?

5.) If a point source of light of **one Candela** is placed at the centre of a sphere of radius one metre then calculate the illumination at surface (in Lux).

Set-A

Name/Id No.-------

6.) Express the relation involving the wavelength (λ) and potential difference(V), in context to the voltage applied to two electrodes separated by a GAS or METAL.

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1st semester, 2013-14

3rd year (EEE)/ Quiz-1/ F.M =16 (8%)/ Date of Quiz-1—21/10/2013/**Set-A**

Course Title ---Electric Power Utilization and Illumination

Course Code No.--EEE F427 / Duration—20 min. [Name/Id No.----]

1.) T_L(Load Torque)=120 Kg-m; T_m=67.6 Kg-m ;T_o=20 Kg-m; t=20 sec; g=9.81 m/sec^2 ;K=.0745 . Calculate the Moment of Inertia(J), in context to "LOAD EQUALISATION" when the load is increasing. --------[04 marks]

2.) The mathematical analysis of LOAD EQUALISATION is completed assuming that an Induction Motor follows:------[02 marks]
(a) $T = K\sqrt{s}$ (b) T=K s^2 (c) T=K s (d) None of them

(3) " A d.c series motor can be started even on no-load using some special technique/ method"-----State that method with basic reasoning/logic.---------- [03 marks]

(4)Consider two windings placed in space-quadrature (distributed in slots) within an electrical machine. The first winding and the winding in quadrature(leading) carry the currents as I_m Cos (ωt) and I_m Cos ($\omega t+90°$) ,respectively . Number of turns of each winding = N . Derive the expression for resultant m.m.f field when both the windings (in parallel) are excited from the same source. What is the typical name of the resultant field? All symbols carry their usual meanings.[5 marks]

(5) Slip of a single phase induction motor with respect to forward field =s. The slip of the same motor w.r.t the backward field will be: ----------[01 mark]

(a)1-s (b)2-s (c) 3-s (d) 1+s

(6) The air-gap power of a single phase induction motor , as viewed from backward rotating magnetic field = P_{gb} .The slip of the motor w.r.t the forward field =s . The rotor copper loss due to backward field will be :

(a) (s+2) P_{gb} (b) sP_{gb} (c) (s-2) P_{gb} (d) (2-s) P_{gb} ----------[01 mark]