Department of Mechanical Engineering
Indian Institute of Technology New Delhi
II Semester -- 2007 - 2008

JGL 710 POWER PLANT PERFORMANCE & MONITORING

MAJOR EXAMINATION

Time: 2hr. 30 min. **Max. Marks: 70**

Note : Hand written notebooks & tutorial sheets are allowed.

Problem 1:

Figure 1 shows the layout of a 500 MW(e) plant steam turbine. Following Table shows the properties of steam at various locations.

Location	T,^{0}C	p, MPa	Flow rate, Tons/hr	
1	529	16.6	1552	
3	341	4.43	167	
4	540	4.24	1413	
5	415	1.8	86	
6	299	0.658	82	
7	298	0.652	1173	
8	208.3	0.185	52	
9	142.8	0.042	92	
10	52.5	0.012		
11		0.0077	1039	x=0.995

Following steam properties are provides for your use:

T, C	P, Mpa	h,kJ/kg	s, kJ/kg.K
529	16.6	3372	6.383
318.2	4.43	2998	6.383
341	4.43	3049	6.485
540	4.24	3534	7.176
399	1.8	3249	7.176
415	1.8	3284	7.227
267.1	0.658	3004	7.227
299	0.658	3058	7.324
298	0.652	3056	7.325
151.5	0.185	2773	7.325
208.3	0.185	2888	7.579
77.05	0.042	2613	7.579

142.5	0.042	2767	7.988
49.42	0.012	2559	7.988
52.5	0.012	2597	8.104
40.7	0.0077	2532	8.104
40.7	0.0077	2564	8.204

Calculate power output and efficiency of all the turbine blocks namely, HP, IP1, IP2, LP1, LP2, LP3 and LP4 .

30 marks

Problem 2:

Explain the characteristics of pump with any four important faults.

10 marks

Problem 3:

Explain all the irreversibilities those exist in a power plant condenser and Derive an expression for thermal resistance due to fouling of a condenser.

Following data corresponds to a condenser before and after cleaning. Evaluate thermal performance of this condenser.

Steam Flow Rate : 1039 tons/hr
Steam inlet pressure : 0.0077 MPa
Steam Quality : 0.95

Hotwell pressure : 0.078 MPa
CW inlet temperature : **32.7^{0}C**
Dirty Condenser: CW outlet Temperature: 43.7^{o}C
Clean Condenser: CW outlet Temperature: 42.5^{o}C

20 marks

Problem 4 :
Explain the importance of Coal Mill Energy Balance Analysis and carryout energy balance of a mill using following data.
Mill Power Consumption : 413 kW
Coal flow rate : 59.1 tons/hr
Primary air flow rate : 98 tons/hr.
Primary air temperature : 287^{0}C
Mill outlet temperature : 85^{0}C
Moisture in coal : 14%
HGI of coal : 55
Estimate the moisture in pulverized coal at the mill exit.

10 marks

Department of Physics, IIT Delhi

PHL110: Fields and Waves **Major** **May 1, 2008**

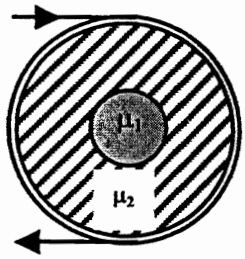
Please answer all the questions. **Time: 2 hours** **Max. Marks: 50**

1(a) A static electricfield distribution is of the form $\vec{E} = A\frac{\exp(-br)}{r^2}\hat{r}$, here A and b are constants. Find (i) the charge density $\rho(r)$ of the source of this field and (ii) the charge enclosed $Q(r)$ in a radius r. **4**

(b)A semi-infinite dielectric slab ($\varepsilon = 2\varepsilon_0$) fills the half space z < 0, with its top surface in the x-y plane the upper half space being a vacuum. A line charge, with charge per unit length λ is placed along the x axis on its surface. Find the electric field produced by it. **3**

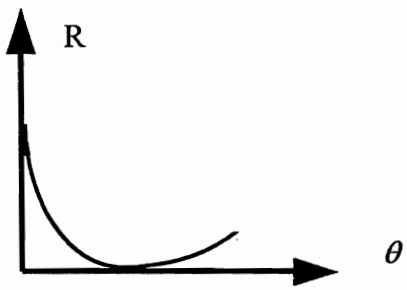
2(a) An infinite cylindrical magnet of radius a = 20mm has magnetization $\vec{M} = \hat{z}\,5x10^5(a-s)$ A/m, where s is distance from the axis of the magnet. Calculate the magnetic flux density $\vec{B}$ every where. **4**

(b) An infinitely long solenoid of circular cross-section with radius R and n turns per unit length has a current I flowing through it. It is completely filled by two concentric cylinders, the inner one of radius a ($a < R$) has magnetic permeability μ_1, and the outer which fills the region between a and R has magnetic permeability μ_2 (cross section being shown in the figure). Find (i) the magnetic field $\vec{B}$ inside and outside the solenoid (ii) the energy density due to the magnetic field inside the solenoid, and (iii) the inductance per unit length of the solenoid. **6**

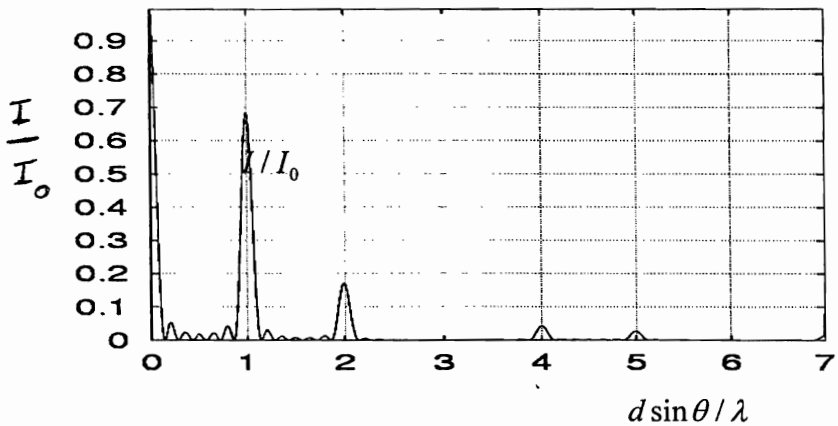


3.(a) The electric field of a plane wave is given by $\vec{E} = (10\hat{x} + 15\hat{y})\sin(8\pi \times 10^{14}\, t - 4\pi \times 10^6\, z)$V/m. Find (i) the wavelength and the refractive index (ii) the magnetic field $\vec{B}$ (iii) the intensity of the wave. **6**

(b) The reflection coeficient R, of a plane-polarized wave in air reflected from glass ($n = \sqrt{3}$) is shown in the figure. What is the polarization of the wave? What is the value of R at $\theta = 0$? What is the value of θ at R =0? **3**



4(a) An aperture contains a certain number of identical and parallel long narrow slits each of width a separated by a distance d. The Fraunhofer diffraction pattern of this aperture is shown in the figure below.



What is the number of slits and what is the ratio d/a. Explain the answers. **3**